DEEP SKY

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When Asteroids Meet Galaxies
The View from Northern Climes

The Galaxies of Orion
Autumn Deep-Sky Challenges

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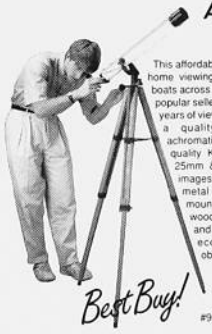


This affordable telescope is equally at home viewing the rings of Saturn or boats across the bay. One of our most popular sellers, it will provide you with years of viewing enjoyment. Includes a quality coated 2-element achromatic objective lens and two quality Kellner .965" eyepieces, 25mm & 9mm, for sharp, clear images at 28x and 78x. Sturdy all metal optical tube and yoke mount, plus strong adjustable wooden tripod, smooth focuser and diagonal prism. A great, economical choice for observers of all ages.

Best Buy!

#9091 **$199** (8.97)

NEW! Celestron Multi Function Focal Tester

For easy, accurate, ultra-sharp astrophoto focusing, and to identify several common optical focal plane errors. Compatible with any telescope equipped with a T-thread camera adapter or off-axis guider.

#7109 **$159** (4.19)

Orion SpaceProbe™ 4.5" Equatorial Reflector

Our affordable reflector for the advanced student of astronomy. 4.5" f/8 reflector gathers 3.6 times more light than 60mm telescopes; twice as much as 80mm models; features a 900 mm focal length and rack-and-pinion focuser. Full featured equatorial mount with slow motion controls & setting circles. Achromatic 6x30 right angle finder and two eyepieces: 25mm (36x) and 9mm (100x). Deluxe hardwood tripod and accessory tray. Compare our price!

#9097 **$399** (22.19)

Orion OmniVista 60 Multipurpose Refractor

- High Performance Design!
- Rich Field Telescope
- 420mm f/7 Telephoto Lens
- Spotting Scope
- Astrograph
- Photo Guide Scope

Shown on Optional Tripod

#9090 **$269** (5.94)

Orion® Big Eye™ 8x50 & 11x80 Finder Scopes

You might spend more time viewing through the finder than through your main telescope! Big Eye Scope is Ideal for upgrading any telescope including Schmidt-Cassegrains. Available non-illuminated or with wireless, adjustable, battery-operated illuminated reticle and Polaris grid for accurate polar alignment. With 90° diagonal prisms. Optional deluxe dual-ring brackets are perfect for 8" and 10" Celestron or Meade; will fit many others, too.

8x50 Models The 50mm objectives gather 2.7 times more light than 30mm finders!

8x50 Standard Finder #7100 **$89.95** (3.95)

8x50 Illuminated Finder #7135 **$129** (4.19)

Bracket— For 50 mm #5143 **$25.95** (2.98)

11x80 Models These huge finders gulp in over 7 times the light of 30mm finders; 2.5 times more than 50mm models!

11x80 Standard Finder#7146 **$199** (4.71)

11x80 Illuminated Finder #7143 **$269** (5.28)

Bracket— For 80 mm #5140 **$37.95** (2.98)

Superior Performance 7x50 Adlerblick Binoculars

Incredible wide field eyepiece design. Fully Multi-Coated, BAK-4 prisms, and best special glass objective lenses make the 7x50 Adlerblick the arch rival of European brand binoculars selling for 3-4 times the price. Orion buys direct, saving you money. Includes deluxe hard case, lens caps and straps.

#9612 **$279** (5.69)

Orion® 10x70 Fully Multi-Coated Enhanced Giant Binoculars

The standard for hand-holdable astronomy binoculars. 33% lighter—weighs only 58 oz.—yet the same brightness and 7mm exit pupil as our 11x80 MC model. Superior 'BCF' body design. Includes: soft rubber eyecaps, tripod mounting adapter, durable hard carrying case, lens caps and straps.

#9501 **$299** (6.97)

Orion® Enhanced® Giant Binoculars

20% more light transmission than ordinary "fully coated" binoculars. Fully Multi-Coated optics and superior BAK-4 prisms provide fantastic contrast and greatly improved edge sharpness.

11x80 MC: Brightest, widest field available. Ideal for deep-space observation under dark skies. Hand-holdable.

#9502 **$369** (8.05)

16x80 MC: 45% higher power, excellent for astronomy and daytime observation. Tripod recommended.

#9496 **$379** (8.05)

20x80 MC: Highest power model perfect for smaller deep-space objects and long range daytime views. Tripod required.

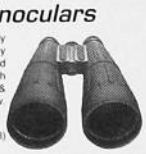
#9498 **$389** (8.05)

Orion® Sky Explorer™ Mini Deep Sky 8x56 Binoculars

56mm objective lenses gather over 2.5x the light of ordinary 7x35 binoculars. Perfect for viewing faint celestial objects, daytime viewing. Best Multi-Coated BAK-4 optics. 6° field of view. Weighs 33 oz.

#9504 **$149** (4.71)

Orion® Little Giant™ 9x63 Roof Prism Binoculars



Popular mid-sized binocular. Fully Multi-Coated and remarkably lightweight. Excellent contrast and sharpness at center of field, with enough power to see lunar craters & Jupiter's moons. 5.5° field of view. Weight 34 oz.

#9500 **$199** (5.08)

Orion® 7x50 Observer™ Binoculars

Our new Observer binocular is an ideal moderately priced night vision binocular for both astronomy and general purpose daytime observation. Fully coated optics with a 7° field of view, and a bright 7mm exit pupil. Rugged ribbed rubber covering for a good grip.

#9620 **$84.95** (4.44)

Orion® 12.5mm Plössl Illuminated Reticle Eyepiece

This new 12.5mm 4-element Plössl offers unprecedented eye relief and observing comfort during long astrophoto exposures. The battery operated integral illuminator has fully adjustable brightness. Features double crossline reticle.

#8484 **$99** (3.45)

World's Finest Illuminated Reticle Eyepiece

6mm Orthoscopic design for required high power guiding, plus unique X-Y adjustable reticle positioning for easy guide star alignment. Wireless LED illuminator has adjustable brightness.

#8487 **$149** (3.67)

Orion® 9mm Orthoscopic Illuminated Reticle Eyepiece

9mm Orthoscopic eyepiece with wireless adjustable brightness illuminator. Bull's-eye within three concentric circles helps measure limits of acceptable guiding error.

#8488 **$119** (3.67)

Orion® 12mm Kellner Illuminated Reticle Eyepiece

12mm Kellner eyepiece with cable plugs into LX/3, LX/5 and Premier drive bases and most drive correctors with illuminated reticle output for polar alignment and guiding.

#8482 **$69.95** (3.45)

Orion® 2" Barlow Lens

2x magnification. Multi-Coated, 2-element 40mm diameter achromatic lens. Baffled to eliminate off-axis glare. Works with all 2" barrel diameter eyepieces. Chrome plated brass barrel and blackened aluminum body with knurled set screw.

#8720 **$79.95** (3.95)

Orion® VariPower™ 2-3x Multi-Coated Barlow Lens

Our best barlow fills the gaps in your eyepiece collection. Internal lens cell slides easily to adjust magnification. Quality optics provide excellent sharpness, contrast and brightness. Works with 1.25" diameter eyepieces and right-angle diagonals.

#8748 **$69.95** (3.45)

Orion® 3-Element Fully Multi-Coated Barlow Lens

Fully Multi-Coated 3-Element Barlow lens provides superior imaging with precise color correction at three wavelengths. For maximum light transmission and highest contrast, we have used the finest quality multi-coating on each air to glass surface. 1.25" diameter.

#8750 **$64.95** (3.45)

Orion® Deluxe Fully-Baffled Multi-Coated Barlow Lens

Fully internally opaqued and baffled to block stray light for noticeably higher contrast. Large 27mm multi-coated 2-element lens provides 2x magnification with any 1.25" eyepiece.

#8746 **$49.95** (2.98)

StereoScope™ Binocular Viewing Expander

Open up a new dimension in observation! The stereo effect of this viewer is astonishing. Viewing is more comfortable and it shows more detail, especially of the Moon and planets. Specially built for astronomical telescopes, features a fully adjustable 55-75mm interpupillary distance scale and a highly precise beam splitter which maximizes transmission of light to each eyepiece and equalizes the brightness of each image. Threads securely onto any Celestron or Meade Schmidt-Cassegrain. Includes a thread-on matched 2x Barlow lens. (Shown with two eyepieces, not included.)

#9720 **$429** (6.13)

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77° Field UltraScan Wide Angle Eyepieces

Unlimited visibility is yours with up to 77 degrees of field to catch your eye. High quality optical materials and superb coatings, for the ultimate in contrast and resolution.

1.25" UltraScan Eyepieces
Five optical elements utilizing the latest high refractive-index optical glass materials achieve extremely wide fields with fewer elements than many competitive eyepieces, reducing weight and cost. Each lens surface is Fully Multi-Coated, for the ultimate in contrast and elimination of stray reflections. Integral rubber eyeguards.

9mm-#8420 **$99** (3.45), *12mm*-#8421 **$109** (3.67)
15mm-#8422 **$129** (3.67), *19mm*-#8423 **$139** (3.67)

2" UltraScan Eyepieces
These incredible oculars provide breathtaking panoramic, bright views that will astonish you!

30mm 2" UltraScan Eyepiece–This 5-element, 77 degree field UltraScan eyepiece combines the widest possible apparent and true fields with a larger image scale than our 40mm.
#8424 **$219** (4.71)

40mm 2" UltraScan Eyepiece - Orion's brightest, widest true-field UltraScan eyepiece utilizes a sophisticated 7-element design, providing a 68 degree apparent field, the widest we could fit into the 2" diameter barrel.
#8425 **$199** (4.19)

High Resolution Orion® Ultrascopic Eyepieces

Unlike other premium eyepieces, Orion Ultrascopics offer complete multi-layer coatings on ALL surfaces, for superior light transmission and contrast. Modern 5- and 7- element designs for pinpoint star images and breathtaking detail. Wide 52° field of view. Compare with other brands selling for much more!

Wide Field 5-element
35mm #8560 **$99.95** (3.45)
30mm #8562 **$89.95** (3.45)
25mm #8564 **$74.95** (3.45)

Medium-High Power 5-element
20mm #8566, 15mm #8568, 10mm #8570, 7.5mm #8572
$69.95 ea. (3.45)

High Power 7-element 5mm #8574, 3.8mm #8576
$89.95 ea. (3.45)

Orion® MegaVista™ 1.25" Wide Angle Eyepieces

Incredible Fully Multi-Coated high-transmission 7-element eyepieces with integral rubber eyeguard and long eye relief.

10.5mm—An incredible 67° field for outstanding planetary or deep space performance.
#8552 **$119** (3.67)

16.8mm—Outstanding high-contrast eyepiece with stunning 70° field ideal for deep space.
#8554 **$119** (3.67)

Orion® UltraZoom™ 7-21mm 1.25" Eyepiece

The finest zoom you can buy for your 1.25" telescope. An excellent choice for astronomy or terrestrial observing. 65°-35° field.
#8556 **$139** (3.67)

Orion® Explorer Series 1.25" Eyepieces

Remarkably affordable, Multi-Coated parfocal eyepieces with great performance. Each carefully selected series has been chosen to provide a sensible progression of magnifications. Threaded for filters. Internally blackened to prevent stray light reflections.

Kellner Eyepieces–
6mm #8536, 9mm #8538, 12mm #8540,
18mm #8508, 25mm #8510, 40mm #8512
$36.95 ea. (2.98)

Orthoscopic Eyepieces–5mm #8500, 7mm #8502,
9mm #8504, 12.5mm #8506, 18mm #8524,
25mm #8526
$49.95 ea. (2.98)

Orion® Explorer Series .965" Eyepieces

Get the most from your small telescope with these fine Multi-Coated eyepieces. Standard .965" barrels fit all Japanese standard small telescopes.

.965" Orthoscopic Eyepieces–
5mm #8580, 7mm #8581
9mm #8582, 12.5mm #8583
$44.95 ea. (2.98)

.965" Kellner Eyepieces
18mm #8584, 25mm #8585
.965" Achromatic Huygenian Eyepieces–40mm #8586
$29.95 ea. (2.98)

Orion® SkyGlow™ Enhanced Light Pollution Filters

Enhance your viewing of faint deep sky objects with the best broadband light pollution filter you can buy. Our SkyGlow absorbs frequencies emitted by city lights, allowing transmission of the rest of the visible spectrum, yielding dramatic results.

SkyGlow Broadband Filters-Photographic and Visual
For use in slight to moderately light polluted areas.

1.25" Broadband Filter–fits 1.25" eyepieces.
#5660 **$69.95** (3.45)

Schmidt-Cassegrain Broadband Filter–fits rear cell of Meade & Celestron SC scopes.
#5658 **$89.95** (3.45)

52mm Broadband Filter–For 52mm camera lenses, adapter rings available for other diameters.
#5668 **$89.95** (3.45)

SkyGlow UltraBlock Filters–Visual Only
For severely light polluted areas and faint nebulae.
1.25" UltraBlock Filter–fits 1.25" eyepieces.
#5654 **$99.50** (3.45)

Schmidt-Cassegrain UltraBlock Filter–fits rear cell of Meade & Celestron SC scopes.
#5656 **$139** (3.67)

Orion® Color Filters for Eyepieces

Solar system observations are dramatically improved by Orion colored filters. For visual use, thread one into the barrel of any standard eyepiece. For planetary and lunar photography, Schmidt-Cassegrain owners can attach the filter to the eyepiece inside the tele-extender. Can also be threaded directly into a universal camera adapter.

Basic Set of 4 Filters .965"- Includes #80A Blue, #58 Green, #25 Red, #15 Yellow.
#5510 **$34.95** (2.98)

Basic Set of 4 Filters 1.25"- Includes #80A Blue, #58 Green, #25 Red, #15 Yellow.
#5514 **$44.95** (2.98)

Expansion Set of 4 Filters 1.25"- Includes #21 Orange, #47 Violet, #11 Yellow-Green, #82A Very Pale Blue.
#5516 **$44.95** (2.98)

Deluxe Set of 8 Filters 1.25"- Includes all the filters in our basic and expansion filter sets.
#5517 **$84.95** (3.45)

Individual 1.25" Filters-#80A Blue (#11040), #58 Green (#5540), #25 Red (#5536), #15 Yellow (#5532), #21 Orange (#5534), #47 Violet (#5538), #11 Light Yellow-Green (#5530), #82A Very Pale Blue (#5544)
$13.95 ea. (2.43)

Moon Filters

Cuts 87% of the light from the Moon. Reduces glare by uniformly reducing light transmitted over the entire spectrum.
.965" #5664 **$14.95** (2.43)
1.25" #5662 **$14.95** (2.43)

Breakthrough Low Price Plössl Eyepieces!

These new Multi-Coated Plössl eyepieces are incredibly low priced! Good quality optics for sharp, clear images. Precision 4-element Plössl lens elements mounted in sturdy aluminum barrels. Available in 12mm, 18mm, or 25mm focal lengths, with 1.25" barrels. Buy all three for less than some single eyepieces!

12mm-#8596
18mm-#8597
25mm-#8598
$44.95 ea. (2.98)

Deluxe Eyepiece Case

Organize and protect your valuable eyepieces and other accessories. This durable case with double hinges holds up to 10 eyepieces plus barlow. Die-cut foam insert for snug secure fit. O.D. 8-1/2"x12-1/2"x3-1/8".
#5913 **$17.95** (2.78)

Deluxe Metal-Clad Accessory Cases

Keep accessories and camera safe and clean. Diced foam inserts can be tailored to your needs. Sturdy handle, two latches, key.
Regular Case: 16"x12"x6½"
#5920 **$59.95** (6.67)
Large Case: 19½"x12"x6½" #5921 **$69.95** (7.10)

Deluxe Field Tripod Tote Bag

Designed for the field tripod with padded insert to separate wedge from tripod during transportation. Specifically made for wedge combinations of Schmidt-Cassegrain telescopes up to 10" aperture. Allows storage without changing polar alignment. This blue bag is made of tear, rip and mildew resistant 100% Cordura nylon.
#15096 **$79.95** (5.19)

Orion® FlexiShield® Dew Caps

Eliminate dew problems with FlexiShield! Better performance, more rugged, and easier storage than rigid dew caps. Forms into a tube with the velcro closure, opens flat for easy storage and transportation. Fits your telescope tube snugly, with wide rubber padding and full length velcro closure—needs no screws. Models to fit most telescopes.

90mm Celestron/Meade Spotting Scopes #4203 **$24.95** (2.78)
90mm Celestron Rubber Armored Spotting Scopes #4205 **$24.95** (2.78)
4" Meade Schmidt-Cassegrain #4204 **$24.95** (2.78)
8" Celestron/Meade Schmidt-Cassegrains #4200 **$39.95** (2.98)
10" Meade Schmidt-Cassegrains #4201 **$49.95** (2.98)
11" Celestron Schmidt-Cassegrains #4202 **$59.95** (3.95)

Orion® Dew Zapper

Orion's Dew Zapper is a sure-fire cure for dew problems on your 8" or 10" Celestron or Meade Schmidt-Cassegrain telescope. Dew Zapper gently replaces lost heat, bringing the corrector plate temperature slightly above air temperature.
8" Dew Zappers-fit all Meade & Celestron 8" Schmidt-Cassegrains
DC Model #3503, AC Model #3504 **$44.95** (2.98)
10" Dew Zappers- fit all Meade 10" Schmidt-Cassegrains
DC Model #3506, AC Model #3508 **$44.95** (2.98)

Dew Remover Gun

Moisture that interferes with viewing dissipates quickly with this 12V DC, 156 watt warm air gun. Has 4-1/2' cord.
#5601 **$17.95** (2.78)

Orion® Slow Motion Adapter

Attaches to your tripod pan head and gives you two slow motion control knobs to make precision adjustments in altitude and altazimuth. Very handy for tracking planets, the Moon, etc. with refractor telescopes and small spotting scopes. Attaches to any camera tripod with a standard 1/4-20 thread.
#7012 **$49.95** (2.98)

Orion® Dual Balance System

Unlike ordinary counterweights, our system allows instant adjustment in both directions. Easily balances your scope to offset both piggyback loads or rear cell cameras, 2" diagonals, and other accessories. Rigid, precision machined dovetail bar mounts to telescope in existing accessory holes.

For Meade SC 8" #5150 **$74.95** (4.78)
For Celestron 8" C-8 #5149 **$79.95** (4.78)
For Meade SC 10" #5152 **$84.95** (4.78)

Starlite Red LED Flashlight

The Starlite is the only adjustable-brightness night-vision red flashlight. Lifetime solid-state LED can't burn out. Extra efficient electronic circuit for long battery life. Uses one 9-volt battery (not included).
#5714 **$24.95** (2.43)

Astronomer's Flashlight

Indispensable and indestructible. Has special night-vision red filter and a diffusion lens for even illumination. An essential addition to your astronomy accessories. Requires 2 D-cell batteries (not included).
#5701 **$9.95** (1.79)

Rechargeable Battery Porta Pac

12 Amp Hour Porta Pac
Ideal for operating your telescope plus higher power-consuming accessories such as an Orion Dew Zapper. Battery is encased in high impact polystyrene. Carrying case of Cordura nylon with shoulder strap and handle. Wt. 10 lbs.
#2354 **$99 ea.** (8.45)

Popular Observer's Chairs

Make observing more comfortable and enjoyable with one of these great chairs.

Standard Model—
Has adjustable height center column and padded vinyl seat. Folds for easy storage.
#5935 **$39.95** (4.70)

Deluxe Model—
Is much heavier-duty, built for professional musicians. Extra thick padding, wide footprint. Adjustable and disassembles for storage.
#5934 **$89.95** (8.02)

Orion® UltraGuider™

Advanced features most requested by advanced deep space astro-photographers at a low price. Use with your Meade or Celestron Schmidt-Cassegrain telescope. Easily adjustable prism allows wider choice of guide stars. Ultra-precise helical focus of your eyepiece, adjustable camera focal plane position
#5139 **$119** (4.19)

Orion® Premium Off-Axis Guider

Multi-Coated for Peak Performance! Low Orion price for our popular, precision anodized guider.
#5144 **$59.95** (3.45)

Rack & Pinion Focusers

These top quality focusers are designed for Newtonian reflectors. Fit any size tubes.

1.25" Focuser
Quality diagonal-cut rack for smooth focusing. Secure slide-fit eyepiece holder. Integral socket for single-stalk diagonal support if desired.
#13017 **$44.95** (2.98)

2" & 1.25" Focuser
Large clear diameter ideal for larger scopes and wide field optics. Precision diagonal cut rack. Long travel for visual and photographic use. Interchangeable 2" and 1.25" holders with set screws.
#13019 **$74.95** (3.95)

Orion® 45-Degree Erect Image Diagonals

See the world as it really is with Orion's new 45-degree erect image diagonal. Upside-down, backwards and topsy-turvy images can often confuse even the stoutest and most experienced observer. Turn it right-side-up with your choice of three models to select from.

.965 Diagonal #8759 **$59.95** (3.45)
1-1/4" Diagonal #8753 **$59.95** (3.45)
Size-Adapting Hybrid Diagonal #8755 **$59.95** (3.45)

Star Diagonals

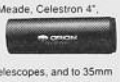
1.25" Star Diagonal
Primarily for astronomical use, lets you view at a right angle. Multi-Coated, for 1.25" eyepieces.
#8763 **$39.95** (2.98)

.965" Star Diagonal
Same as 1.25" Star Diagonal, but with standard coated optics. Works with .965" eyepieces and eyepiece holders.
#8761 **$24.95** (2.98)

2" Star Diagonal

Get the widest possible field of view from your Schmidt-Cassegrain Telescope. This star diagonal features a special aluminized and overcoated precision first-surface flat mirror.
#8767 **$99.95** (3.45)

Orion® Tele-Extenders



For high powered photography with your Meade, Celestron 4", 8", 10", 11", 14" Schmidt-Cassegrain.

Standard Tele-Extender
Use this Tele-Extender in conjunction with an eyepiece. Attaches to visual back of Meade or Celestron Schmidt-Cassegrain telescopes, and to 35mm camera with T-ring, sold separately.
#5125 **$27.95** (2.98)

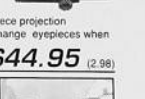
Variable Tele-Extender
Uses an adjustable extension tube, allowing magnification to be changed without switching eyepieces. Attaches with T-ring, sold separately.
#5127 **$39.95** (2.98)

Universal Camera Adapters

Standard Universal Camera Adapters
Combination Eyepiece Projection Tube and Prime Focus Adapter for refractors and reflectors with 1.25" eyepiece holders. Use with T-Ring (sold separately) to match your 35mm camera.

.965" #5268 **$29.95** (2.98)
1.25" #5264 **$34.95** (2.98)

Variable Power Camera Adapter



Unique sliding barrel design allows variable projection distances during eyepiece projection photography, eliminating the need to change eyepieces when magnification changes are required.
#5262 **$44.95** (2.98)

Orion® T-Adapter

For prime focus photography. Use with T-ring to match your 35mm camera. For Meade, Celestron 4", 8", 10", 11", 14" SC. Can be used as 2" camera adapter.
#5116 **$27.95** (2.98)

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DEEP SKY

THE MAGAZINE FOR DEEP-SKY OBSERVERS AND ASTROPHOTOGRAPHERS
FOUNDED IN 1977 BY DAVID J. EICHER
AUTUMN 1991 VOLUME 9, NUMBER 4

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by Tom Polakis
Ride along for an updated cruise through our very own home cluster of galaxies.

20 Deep-Sky Magic Returns to the Texas Star Party
by Robert Reeves
The legendary observing get-together last summer thundered back from bad weather and offered a long run of clear, dark nights.

26 Observing from the 65th Latitude
by Riku Henriksson and Petteri Rajanen
Shake off the poor reputation of the extreme northern sky with a dazzling tour of dozens of magnificent galaxies and nebulae.

Cover: NGC 205 photographed by Kim Zussman (modified 11-inch f/10 SCT, hypersensitized Tech Pan film, 65-minute exposure).

Opposite page: Barnard's Galaxy photographed by Chuck Vaughn (14-inch SCT at f/7, hypersensitized Tech Pan film, 60-minute exposure).

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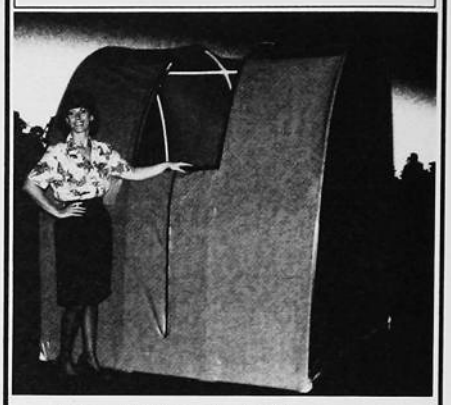

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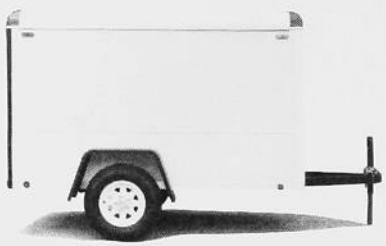

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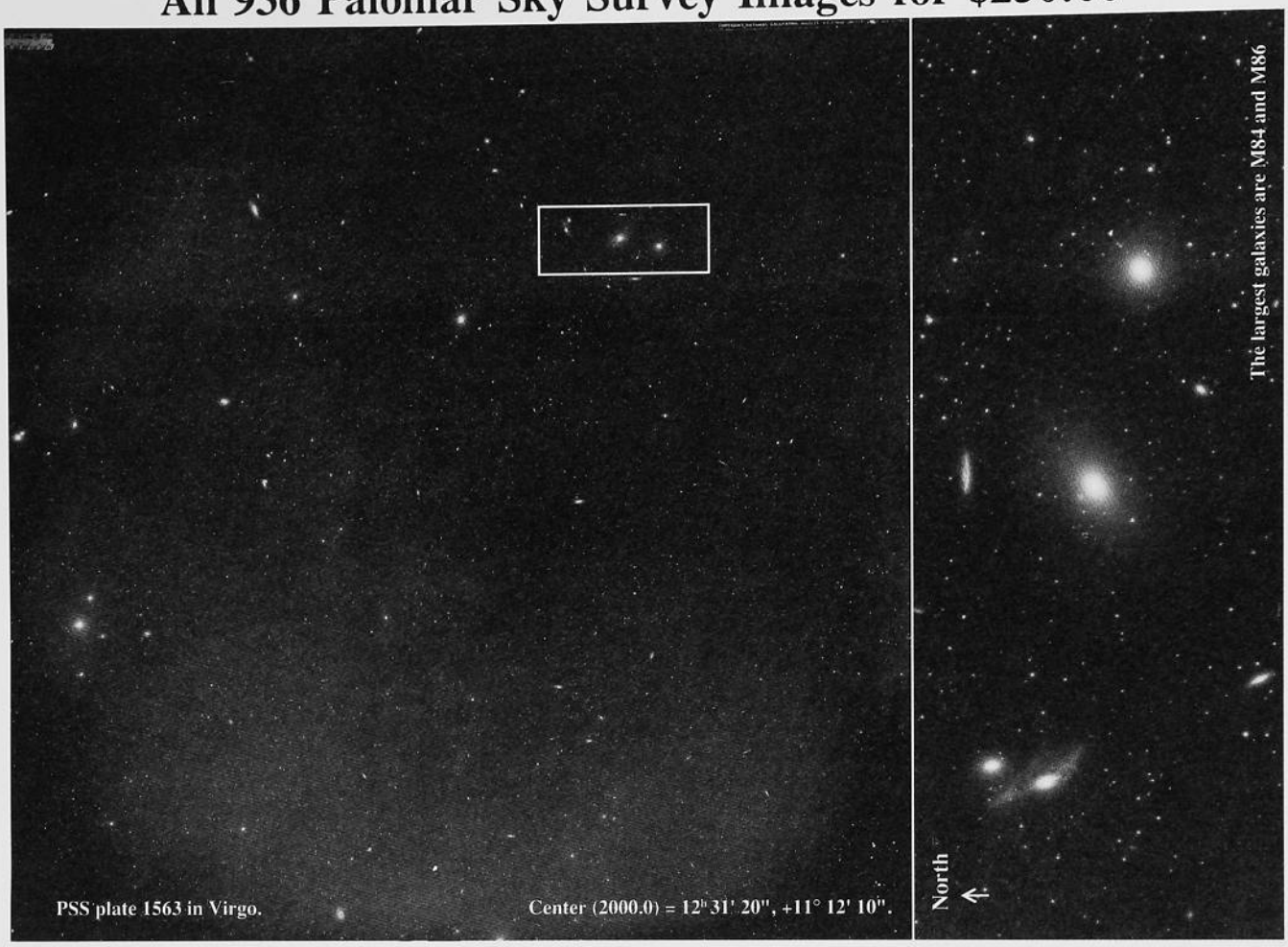

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AT THE EYEPIECE

Greetings from the 1991 Texas Star Party, Fort Davis, Texas. Photo by Ed Flaspoehler.

Around about this likeable time of year deep-sky observers have it made. The hazy nights of summer are gone and the cool, crisp evenings of autumn set in, bringing with them some of the best observing conditions one can experience in many parts of the nation. Yet that spectacular arch of summer Milky Way with its numerous attractive objects is still visible. Who could ask for anything more?

Galaxy observers, that's who. Those people who can't take a break from craning their necks and jamming their drive gears by frantically doting on things beyond the Milky Way. (I should know, I'm one myself.) With this in mind, we present Arizona observer Tom Polakis' article on the Local Group of galaxies. Months of research and dedication have helped Tom produce the definitive article on this subject, one we hope you will enjoy.

With best wishes for a great observing season,

Dave Eicher

Discovering Sharpless 2-157

Dear Dave / While in the area of the Bubble Nebula, I came across a fascinating large nebula, Sharpless 2-157. The two bright areas I could see covered an area about 50' by 40', but in a photograph in Hans Vehrenberg's *Atlas of Deep-Sky Splendors*, the nebulosity extends over several degrees. I was using a 12.5-inch reflector at 75x. With an O III filter the two areas were fairly well defined; without the filter they were invisible. The coordinates for this object are R.A. 23h16m, Dec. +60°. This nebula will certainly be put onto my "must return to" list and I hope others will explore it and report their findings. — *Randy Pakan, 11133 — 19 Avenue, Edmonton, Alberta, T6J 4Z5 Canada*

What about NGC 6723?

Dear Dave / While scanning Robert Bunge's excellent article in *Deep Sky* #34, "Unknown Globulars of Sagittarius," one of his comments caught my attention. About the globular NGC 6723 he writes, "...this object was very nicely resolved in the 31-inch even though it appears to have a low surface brightness." Several years ago I accidentally discovered this object while sweeping around near the southern horizon. Since NGC 6723 had not yet been mentioned in *Deep Sky* before (I think) and because it is so far south (at -36°38'), its brightness came as quite a surprise to me. My immediate reaction was, "If this globular were located at +36° instead of -36°, it would be one of the best known in the northern sky." Is it possible that Robert's relatively high-latitude observing site in northern Ohio was to blame for his assessment? NGC 6723 rises as high as 20° at my latitude in Dallas, Texas, and it does not appear to have a low surface brightness under clear skies with no haze. — *Jason Adamik, 8215 Meadow Road, #1037, Dallas, Texas 75231*

A Long Time Ago in a Magazine Far, Far Away...

Dear Dave / I missed the editorial in *Deep Sky* #22 (published in the spring of 1988) when it first appeared. (Honest, I really missed it — I'm not that far behind on my *Deep Sky* reading!) The editorial dealt with Brian Skiff's negative review and my positive review of

Oddball nebula Sharpless 2-157 sketched by Randy Pakan (12.5-inch f/4.5 reflector at 75x with an O III filter.

Uranometria 2000.0 as they appeared in the February 1988 edition of ASTRONOMY magazine. In this editorial, you made a statement that was untrue or, at best, a gross exaggeration. Because it has been a long time, I will quote your editorial: "A review by Dick Suiter that follows unabashedly drools over this new atlas, unaware that it contains any serious flaws."

Dave, I take issue with this rather unflattering appraisal of my review. In that published review I stated: "Some errors in the *Revised New General Catalogue* (*RNGC*) have been propagated in this atlas, but the list of errors is small. If the atlas has a weakness, it's the haphazard criteria for including dark nebulae." I went on to point out that no Barnard objects had been plotted (a problem that has long since been fixed, by the way). This is hardly drooling, and it exhibits the knowledge that errors exist.

In fact, I had before me (at the time I wrote that review) an unpublished work by Brent Archinal gathering together all known errors in the *RNGC*. Many of these were identified by Harold Corwin of the University of Texas, and had been privately communicated to Archinal. Because this work was unpublished, I felt it would be unethical for me to quote errors I found in *Uranometria 2000.0* using this listing as a source document — the right of first publication belongs to the people who did the work of digging them up. I did point out that the most serious and well-known error in the *RNGC*, the wrong

sign on the declination for NGC 246, had been happily corrected.

These specifics were edited out of the final published version. Apparently, the editors of ASTRONOMY believed that Skiff had covered the errors well enough already. Dave, you should know, if anyone would, how the editorial process can occasionally distort information transferred between the author's pen and the printed page. A good example of this is another quote of my review, where you followed the word "watermark" with a rather condescending [sic], (the Latin abbreviation that indicates a usage or spelling error had been committed). I used the word "benchmark" in the manuscript. You were criticizing ASTRONOMY's editor!

Anyway, three years later, I believe I have been vindicated in my original high opinion of the *Uranometria 2000.0* atlas. It is cited monthly in the major astronomy magazines. If you see a map with something else plotted on top of it, nearly always the underlying chart is *Uranometria 2000.0*. It is an enormous publishing success. True, it still has flaws, but I think the benefits outweigh the relatively minor errors. As incremental corrections and improvements are made between printings, this atlas continues to get better and better. — *Dick Suiter, 3913 Pisa Drive, #B-3, Panama City, FL 32405*

Postcards from Finland

Dear Dave/I've been reading your magazine for a couple of years now, and it is admittedly the best of the branch. Enclosed is some material on deep-sky observing in Finland — not exactly from down under. I hope you find the sketches interesting, especially because the observing conditions here are not perfect, but we try to manage.

Of the *Deep Sky* magazine itself there is hardly anything blamable; those special research articles on Palomar or Tombaugh clusters are fascinating. So finally, as you blokes traditionally say — keep up the good work. — *Petteri Rajanen, SF-95210 Filpus, Finland*

Books for Sale?

Dear Dave / I am a subscriber to your excellent magazine *Deep Sky*, a member of Webb Society, and a regular contributor to the Swedish Amateur Astronomy Association's magazine ASTRO. I am also leader of the Swedish Association's Deep Sky section. The reason that I write to you is that I am interested in buying papers and books concerning different deep-sky objects, especially concerning galaxies and clusters of galaxies. The books and papers could be second-hand, but the most important is that they are on a relatively advanced level. If you yourself or some other reliable person has anything to sell, please send a list with titles and prices to me. You know, it's hard to get advanced literature in Sweden concerning topics like astronomy.

I also include a few sketches of deep-sky objects that I have drawn at the eyepiece. Please let me hear from you. — *Jan Sandström, Parkgatan 29, F 671 00 Arvika, Sweden*

— *Do readers have any books they wish to sell? Let's help out if we can by sending short lists of books you wish to sell to Jan Sandström.*

A Danish Deep-Sky Fellow

Dear Dave / After reading your magazine for years, I must say it's getting better and better. Most of all, no where else could a deep-sky observer get such splendid information and photos on lesser-known objects outside the solar system.

Now I'm sure you know the situation. On a clear night you gaze at a rarely observed galaxy and discover a faint detail in the soft, gray light. Is it a spiral arm, an HII region, or what? How easy is it to see with a given size telescope?

One of the great pleasures of amateur astronomy is just to find the answers to these questions! There is an old saying that goes something like this: It's not important to remember facts, you just have to know where to look for them. And *Deep Sky* surely is a promising place to look. A photo or a detailed description can help you to explain what you observe. But searching closely through dozens of *Deep Sky* issues and books can be frustrating.

For some time I've considered how to gain access to large amounts of published information. My solution might not be new or workable at first, but I've had fun on the project, so I suspect others could find my idea useable too.

Many amateur astronomers own a computer, right? Well, I've spent many nights over the past several years keying in notes on photos, descriptions and so on regarding deep-sky objects. Such a computer index saves a great deal of time because it includes my own observing notes and references where I can find data on certain objects.

The advantage with such an observing list on computer is obvious. I can select clusters I've never seen previously north of Dec. +40° and with a diameter less than 20'. Within one minute, the computer runs through the 8,000 objects and lists maybe ten to twenty objects of interest.

Now the problem isn't what to look at in the sky but to gain more information about the objects. — *Tommy Christensen, Assensvej 18, DK-5750 Ringe, Denmark*

Catalog Confusion

Dear Dave / I was very pleased to see my article, "NGC 7129 and NGC 7133: An Identity Crisis" in the Winter 1990/91 issue. However, there is an error in the article that was pointed out to me by Alister Ling. In the second to the last paragraph on page 34, the text reads, "The French astronomer M. G. Bigourdan observed NGC 7129 and added a second object which he placed 172" north and 84" west of NGC 7129."

My original manuscript and the notes from Malcolm Thomson on which this passage was based, read that he placed the second object 1'24" (84") following NGC 7129. In other words, to the east, not the west. This is an obvious example of how a simple change of a single word can cause confusion in these catalogs! — *Gordon Bond, 313 Raphael Avenue, Middlesex, New Jersey 08846*

Binocular Observing Report

Dear Dave / One-third billion light years with large binoculars? That is to be considered in the following items, as recent issues of *Deep Sky* asked for observations of Coma Berenices. I had hoped to make fresh observations before writing, but lingering, soggy, cloudy weather prevented it.

NGC 4565, the great edge-on galaxy of Coma Berencies, is very easy to locate. Find 12 and 17 Comae Berenices in the Coma Star Cluster, then move east about the same distance as the separation of the two stars. With a reasonably clear sky you could hardly miss it with a 3-inch, but an article in the June 1966 *Review of Popular Astronomy* reported that a 10x binocular may show the galaxy. I seem to recall that John Bortle saw NGC 4565 with 10x50mm binoculars, but I have yet to succeed myself.

I certainly did see NGC 4565 in my 2.4-inch short-focus refractor at 21x. My 8-inch reflector at 116x shows the brighter field stars near to it, just as in photos. The 8-inch gives hints of the central obscuring lane when I see stars as faint as magnitude 14.5.

I first saw Abell 1656, the Coma Galaxy Cluster, in my 8-inch scope in 1979. I wondered then how small an aperture could show it. Trials with several instruments over the years led me to glimpsing the two brightest member galaxies with a 2.3-inch scope at 58x. Perhaps at the next Texas Star Party the skies will be ideal for someone to find

out whether or not large binoculars are enough to show NGC 4889, whose total V magnitude is 11.4.

Finders and binoculars with large exit pupils can't be expected to reach the magnitudes that their apertures may suggest. Few binoculars exceed 20x. My 40mm finder at 12x has reached magnitude 10.1, using an AAVSO chart for R Leonis. Raising the magnification to 50x added another 0.5 or 0.6 magnitude. My short 60mm refractor shows stars as faint as magnitude 12.0 at 19x, so 20x80s under good TSP skies should reach to the faintness of Abell 1656. Happy hunting! — *Gus Johnson, RD 2, Box 67, Swanton, Maryland 21561*

Autumn Challenge

Dear Dave / I would like to share some observations of challenging deep-sky objects.

M76. This planetary is considered by many in the literature as the most difficult Messier object. I found it to be a rather easy object — greenish and easily visible with direct vision on my 8-inch SCT at 154x. Its shape was rectangular and it was quite small. In fact, the surface brightness of this object seems to be higher than that of M1. A Lumicon Deep Sky filter enhances this object and makes its bow-tie shape more evident.

M74. This object is a real challenge. I did not have any problem in finding its field, but finding the object was difficult. I had to scan the field of this object for five nights before finally perceiving it last November 19. This object was only visible with averted vision. It had an oval nucleus with very faint spiral arms. In my book this is the most difficult Messier object.

NGC 7293. This is, of course, the Helical Nebula. Phil Harrington says this object is a real challenge for a 2- to 3-inch binoculars. Well, I found this object easily with my 10x40mm binoculars. The nebula was a faint spherical glow easily seen with direct vision. When I first saw it, I could not believe that I was staring at it. Surprisingly, this object proved to be very difficult with my 8-inch SCT, even at 50x. It looked like two rings superposed on each other and visible only with averted vision. A filter improved the contrast of this object.

M33. This is another easy object for my binoculars. In fact, it is so large and bright that I could resolve the spiral arms. This object was faint in my 8-inch SCT at 50x. It had a faint core, but it was visible with direct vision. Mottling was seen in the spiral arms with averted vision.

These are some of the interesting objects which I had been hunting these days. My recommendation to beginners is not to believe that an object is difficult until you have hunted it yourself. I would also to comment on your magazine's trend to serve the large scope owners. Please do not forget us small scope owners. I like your new format. It's neat! Until I write you again, more power to *Deep Sky*. — *Christopher Go, 81 Espeleta Street, 6000 Cebu City, Phillipines*

Deep Galaxy Shots

Dear Dave / I have enclosed two photos of galaxy clusters you mentioned in your Fall 1988 and Fall 1990 issues. The first photo is of the NGC 128 galaxy group. This group was described by David Higgins in his article on Autumn's Galaxy Groups. NGC 128 shows itself as a spindle shape galaxy with a hexagon-shaped nucleus. *Sky Catalogue 2000.0*, volume 2, describes this galaxy as having a box-shaped nucleus in the back of its galaxy section. Is this shape influenced by the gravitational interactions of its two small satellite galaxies? One of them seems to be connected to NGC 128 by a bridge of luminous matter. It would be interesting to see a computer simulation that would generate NGC 128's strange appearance. NGC 125 is a small, barred, open-armed spiral seen face-on; the two stars that lie northwest of it, as mentioned in Higgins' article, are almost as bright as NGC 125's nucleus. In all, I counted ten galaxies comprising the core of this group; many of them being 16th magnitude or dimmer.

I was inspired to take my second photo by Steve Coe's sketch of the NGC 68 group in the Fall 1990 issue. Despite Bob Buchheim's failure to detect this group in his 13.1-inch reflector, I found little difficulty locating this group in my C-11; this could be due to the superiority of my site, Mt. Pinos, California, versus his, Anza, California. I visually detected two galaxies with certainty and saw two more with averted vision. The number of field stars in the area makes galaxy identification difficult visually. In my 210-minute exposure, I counted roughly 20 galaxies around the core of the NGC 68 group. NGC 70 has a halo of material common with that of the galaxies near it. Does the compactness of this cluster enhance tidal interactions on a galactic scale? It would be interesting to compute how far away NGC 70 is to its neighboring galaxies, and what size each galaxy would appear to be in the skies of its companion star systems.

I also enclose a photo I made of NGC 660. This is a peculiar galaxy in Pisces of the spiral type. What is interesting about this system is the faint luminous ring of material that seems to be encircling the bright nucleus; also note how the dust lanes of this system seem to be at right angles to each other. By the way, the R.A. of this system is around 1h43m. I took this shot from Mt. Pinos. The duration of the exposure was around 196 minutes with a C-11 working at f/11. I hope you or one of your readers can explain the history behind this strange structural galaxy. Is it two galaxies in collision, an exploding system, or one that is experiencing rapid star growth?

I hope you enjoy these pictures (and comments?) and feel free to share these with your readers. Clear skies with no wind to you! I look forward to see your upcoming issues of *Deep Sky*. — *James Foster, 1335 North Poinsettia Place, #4, Hollywood, California 90046*

Tracking down Holmberg II

Dear Dave / I read with interest Brian Skiff's column "Scanning the Literature" in the Spring 1991 issue, specifically his successful observation of the dwarf irregular Holmberg II (UGC 4305). Having observed the field of this galaxy many times with a 14-inch scope, I can tell you it is a tough object.

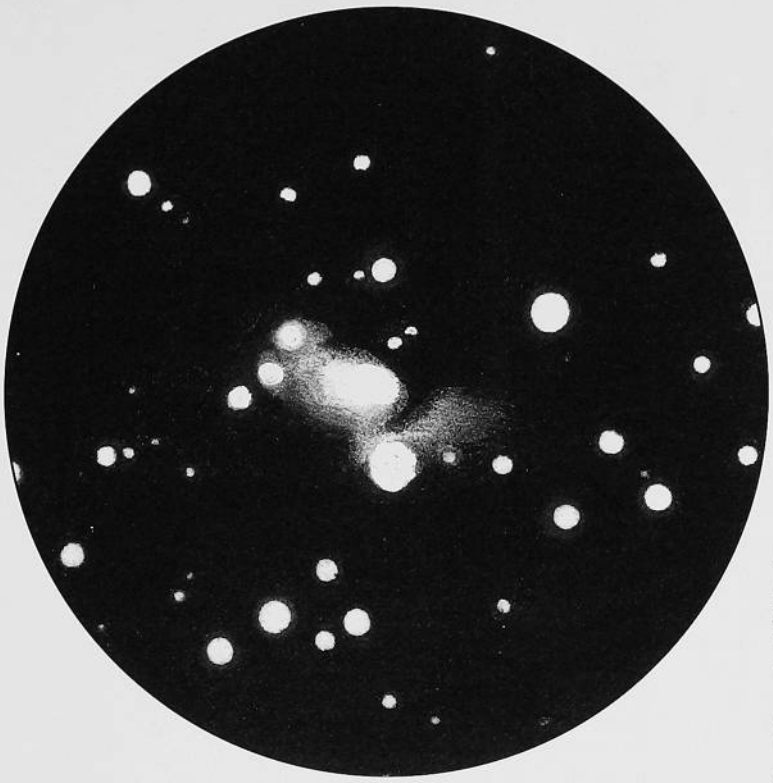
The galaxy also has several compact knots, some of which are well within reach of medium-sized scopes under good conditions. These knots are located close to a triangle of field stars (magnitudes 12 to 14) that can hinder viewing slightly. But with good seeing and medium-to-high powers, at least two small, faint patches of light should be visible, one immediately west of the triangle, the other just east of it.

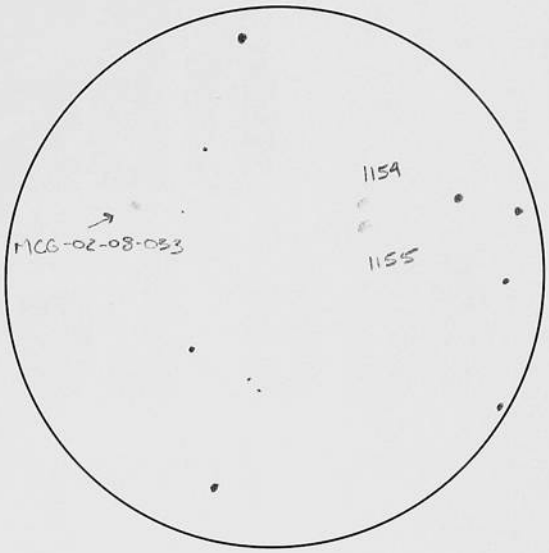
An excellent photo of this galaxy taken by Allan Sandage appears in the Hubble Atlas of Galaxies, and can be used to help zero in on the correct field.

So while the galaxy itself is a very difficult object under less than perfect skies, observers have a good chance to see its "Orion nebulae," glowing dimly in the distance. — *Eugene Brings, P.O. Box 582, Mendocino, California 95460*

The Good Old Messier Marathon

Dear Dave / I don't know if you are planning on giving any coverage to this year's Messier Marathon in the magazine, but in case you are, here are my results. Actually, I ran a Messier Biathlon, using my 13.1-inch f/4.5 reflector and, mounted separately, a pair of 11x80mm binoculars. For my site I chose an open field in Southold, New York, on Long Island's north fork. The night (March 16-17) was quite clear, with both Mercury and the zodiacal light visible in the west after sunset. We were also treated to a view of Cen-





Left: The extraordinarily challenging galaxy Maffei 1 sketched by James R. Foster of Hollywood, California. Foster used a photographic print to render the exact position of the subtle and contrasty parts of the nebulosity.

Above: The faint galaxies NGC 1154, NGC 1155, and MCG 02-08-033 sketched by David Hasenauer, who used a 17.5-inch f/4.5 reflector at 130x. The field of view is about 35'.

tarus A in the early morning hours, but Omega Centauri was just too low to be seen (although I did see several stars at the same declination).

With the 13.1-inch, I found 109 M-objects, missing only M30 in Capricornus. Using the 11x80mm binoculars, I spotted 101 objects. In addition to M30, I missed M2, M55, M69, M70, M73, M74, and M75. All but M74 should have been relatively easy in the 11x80s, but not when the lenses are frosted over! We hit the dew point at about 2 a.m., and by 3 a.m., the lenses were beyond the limit of my little 12-volt hair dryer/dew zapper. That's the price you pay for living on an island.

Here are a couple of other results you might be interested in. At another site a few miles away, Sam Storch of North Merrick, New York, saw 100 M-objects using his 17.5-inch reflector. Across Long Island Sound in Westport, Connecticut, members of the Westport Astronomical Society (to which I belong), led by Cal Powell and Gary Oleski, successfully located 106 objects through the Roolnick Observatory's 12.5-inch Newtonian.

All in all, it wasn't a bad year. And for the first time in several years, the sky didn't cloud up after midnight! — *Phil Harrington, 54A Dillmont Drive, Smithtown, New York 11787*

Galaxies and Comets

Dear Dave / On the night of January 12th, I had a memorable observing experience that I though I would share with you and your readers. I was observing from a remote dark-sky site near the Chuckwalla Mountains of Southern California with another deep-sky enthusiast, Bob Amann. I was picking up galaxies in western Eridanus with my 17.5-inch Dobsonian, when I thought I discovered a comet! I had star-hopped from Eta Eridani to the galaxy NGC 1140. Bright enough to appear on Tirion's *Sky Atlas 2000.0*, the galaxy was quite small with a stellar nucleus. From it, I scanned over to the galaxy pair, NGC 1154 and NGC 1155. These galaxies are too faint for the *Sky Atlas 2000.0*, but are plotted on chart 266 in Tirion's *Uranometria 2000.0*. Both were quite faint and small. NGC 1154 showed some brightening toward its center while NGC 1155 was more uniformly illuminated. As I observed them, I noticed another nebulous patch about the same size and brightness less than 20' away. It looked just like a galaxy, appearing to be of similar brightness and size to NGC 1154 and NGC 1155. It didn't make any sense that it was not plotted on *Uranometria*. Bob made a quick check of Sinnott's *NGC 2000.0* to determine if Tirion accidentally missed this object, but no NGC or IC object was located at its position. Meanwhile, I was making a very careful sketch of the field in case the object moved.

Bob and I both thought the object might be a comet that was already known. We had positions for four comets: P/Metcalf-Brewington; Comet Tsuchiya-Kiuchi; P/Wild 2; and Comet Levy. None of these objects were located near the position in question, and during the course of the night, we observed all four. Over the next three hours no obvious motion was detected. I returned the next night, recovered the field, and found that the object had not moved. In the meantime, I phoned my friend Al Bowen, and gave him the object's position. He has an extensive library and said he would research it. A few days later Al called to let me know that the object might be the galaxy MCG-02-08-33 (from the *Morphological Catalogue of Galaxies*). I live fairly close to the California Institute of Technology, so I decided to try and confirm this by examining the *Palomar Observatory Sky Survey* print of this area. The librarian was extremely helpful, and upon examination of field #1467 it became obvious that MCG-02-08-33 was indeed the object I had "discovered." On the print it looked more like a galaxy than either NGC 1154 or NGC 1155. The object's equinox 2000.0 coordinates are R.A. 2h55m24s, Dec. -10°10.'1, and it is listed in the MCG as glowing at 14th magnitude.

I was a little disappointed that I had not discovered a comet, but the thrill of discovery was still present and the experience makes me wonder how many other non-NGC or IC galaxies are within reach of my scope. — *David Hasenauer, 3202 East Foothill Blvd., #116, Pasadena, California 91107* □

Observing the Local Group

An exploration through our own galaxy cluster

by Tom Polakis

One of the most fascinating properties of the universe is that gravity applies at all scales. This can be seen from the Moon's lock into an orbit about Earth all the way up to the arrangement of galaxies in superclusters. Amateurs often observe galaxy clusters, from the nearby Virgo cluster out to distant groupings such as the Corona Borealis cluster. Our own Milky Way galaxy is a member of the galaxy cluster called the Local Group.

The center of the Local Group lies approximately between the Milky Way and the Andromeda Galaxy, M31. Extending around this center to a radius of about 1.5 megaparsecs is a cluster of over thirty galaxies, most of them within reach of amateur telescopes. The great bulk of the mass of the Local Group is contained within the Milky Way and M31. These two galaxies, in fact, are massive enough to have their own satellite galaxies. The Milky Way has eleven known companions and M31 sports seven.

What makes a galaxy a member of the Local Group? The best discussion of this subject, although somewhat technical, appears in *The Astrophysical Journal*. Authors Amos Yahil, Gustav Tammann, and Allan Sandage (1977) build on Edwin Hubble's observation that Local Group members do not partake in the general cosmological expansion seen everywhere else in intergalactic space. The authors use existing radial velocity data to define membership on kinematic grounds, rather than just arbitrarily stating "it's nearby, so it's a member." For membership in the Local Group, a galaxy must be moving with our cluster independent of the "Hubble flow" (expansion). By plotting the spatial distribution of the galaxies, the diameter of the Local Group was shown to be no less than 3 Mpc.

The list of Local Group members here is adapted from Paul Hodge's book *Galaxies*, with a few additions of recent discoveries made since the book's publication in 1986. This list is the most consistent with the definition of Local Group membership. Note the absence of some pretty well resolved nearby galaxies like Maffei I, NGC 247, and Sextans A, which have been denied membership in recent years based on their measured velocities .

For the visual observer, the Local Group galaxies are interesting because we can see features commonly observed in our own Galaxy, such as nebulae and star clusters. Although all but three of the members are elliptical or irregular, there is a wide variety of galactic structure to be observed. Because of their extremely low surface brightness, spotting many of these objects provides the utmost challenge to amateurs. Paradoxically, these are also the closest members, the dwarf ellipticals.

Most Local Group galaxies can be found in the evening autumn sky. Since we are dealing with some difficult objects, the most careful practices of deep-sky observing are required. Full dark-adaptation and a dark sky are required to see these galaxies in any detail. I found that slowly sweeping the telescope across the objects helped in first detecting them. A good wide-field eyepiece giving an exit pupil of at least 5 mm will help, too. One important observing accessory is a dark cloth to block out any local lights or skyglow, available at fabric stores for a few bucks. Although this antisocial behavior seems a little strange at star parties, several minutes under the monk's hood assists dramatically on faint objects.

The Local Group galaxies in this article are arranged by type. We'll start our tour with the companions to the Andromeda Galaxy, then take a look at the irregulars and remaining ellipticals of our galaxy cluster. The "big four" (M31, M33, and the Magellanic Clouds) are too detailed to be covered here. M31 has been covered in previous issues of this magazine by Brian Skiff (1984) and by David Higgins (1990). An article by Skiff (1983) covers M33 in detail.

The Andromeda Companions

Let's start out with M31's seven companion galaxies. In the same low power field with the Andromeda Galaxy — and familiar to every amateur — are **NGC 205** and **M32** (NGC 221). Imagine the view of M31 from one of those galaxies. The sky would be filled with this spectacular spiral, blocking any of the sky behind it with its stellar associations and dust clouds. The Andromeda Galaxy has made its presence known gravitationally as well because both NGC 205 and M32 show evidence that their outer regions have been distorted by tidal forces. In my 13-inch f/4.5 Newtonian from a dark Arizona site, NGC 205 shows a 9' by 5' halo, oriented in position angle (p.a.) 150°, which is steadily brighter to the central arcminute, where a bright core blazes. There is a 12th-magnitude star halfway out to the south end of the galaxy's face. M32 is always obvious next to M31, even from urban observing sites. It is quite small, only 3' by 2', elongated north-south, with a very bright center and a rapid fall-off to the sky background. It takes high power well, showing a 7th-magnitude star 12' away in p.a. 30° and several other 9th-magnitude field stars within one-half degree.

Detached from M31 and its two immediate companions are **NGC 147** and **NGC 185**. These serve as a preview of the

The elusive galaxy NGC 6822 in Sagittarius is one of the splendors of our Local Group. Four major HII regions are visible in this hydrogen-alpha image. Are these visible in backyard telescopes? Photo courtesy Paul Hodge.

typical appearance of Local Group galaxies: dwarfs of low surface brightness. The two are close enough in space that they are likely gravitationally bound. In the 13-inch, NGC 147 appeared to be 8' by 4' in size although its published size is 13' by 8'. This is quite common as the professional definition of "size" is often for a lower level of brightness than can typically be seen in amateur scopes. The galaxy appears nearly uniform at first glance but begins to show some central brightening after a while. The field at this low galactic latitude is peppered with many stars, including a 13th-magnitude star embedded in the glow just west of the nucleus. One degree to the east, NGC 185 can be squeezed into the same low power field with NGC 147.

It is more easily seen than the latter, showing a 5' by 3' halo around a bright center, similar to a spiral galaxy. By cranking the power up to 215x, however, there was no sign of the stellar nucleus we'd see if it were actually a spiral. This magnification began to reveal a grainy texture to NGC 185, unlike its companion to the west. There are five known globular clusters in this galaxy (Hodge, 1974). At high power (310x), I was able to see globulars #l and #2, with #2 being more visible, even appearing nonstellar. Globular #l was stellar and visible only about 10 percent of the time.

Visibility of the Andromeda Galaxy's companions drops off quickly after these four bright ellipticals. **Andromeda I**, **Andromeda II**, and **Andromeda III** are exceedingly faint dwarf elliptical galaxies discovered by Sidney van den Bergh (1972) in a search of 48-inch Schmidt plates. These plates, which were of higher quality than those from the *Palomar Observatory Sky Survey* (*POSS*), were taken in 1970 specifically to search for companions to M31. Andromeda I and II were later verified by their appearance on the *POSS*, but Andromeda III remains invisible on these plates. Also found on the 1970 plates was **Andromeda IV**, but it was soon dismissed as a non-member of the Local Group. Visually, only Andromeda I was readily seen in my 13-inch as a 4' diameter, round glow of uniform surface brightness, just above the brightness level of the night sky. Eight 12th- and 13th-magnitude stars appeared over its face in a small group. During several persistent attempts, I was not convinced I saw either Andromeda II or III. Andromeda II is situated behind a faint Milky Way star cloud which gives some false hope. It would be interesting to know if larger apertures (24-inch?) can dig up these galaxies.

The Irregulars

Perhaps the most interesting members of the Local Group are its dwarf irregulars. These often show the same features found in spiral galaxies such as H II regions, star clouds, and dark nebulae. Again, this class of galaxies runs the gamut of brightness. In Sagittarius alone they range from the much-observed NGC 6822 to SagDIG, a nearly invisible dwarf.

E.E. Barnard discovered the first entry on our list with his 5-inch refractor in 1884. **Barnard's Galaxy**, now known as NGC 6822, was important in Edwin Hubble's early work with determining the distance scale to these types of "nebulae." Hubble's 1925 paper was the first to demonstrate the use of the period-luminosity relationship of Cepheid variables to regions outside our own Galaxy, making this the first object to be shown conclusively to be extragalactic. And Barnard's Galaxy has been much studied since this time. Paul Hodge (1977) found 26 additional star clusters in addition to the original five found by Hubble. He also catalogued eleven new dark nebulae and added eleven H II regions to Hubble's original list of five. Several of these, we will see, are visible in modest-aperture scopes.

NGC 185 in Cassiopeia is one of the two challenging satellites to M31. Are the dust patches in this galaxy visible in backyard scopes? Photo by Harvey Freed (10-inch SCT at f/6.3, hypersensitized Tech Pan film, 45-minute exposure).

The overall appearance of NGC 6822 is of a pretty even 9' by 4' glow elongated north-south. A faint "bar," much discussed in the literature, is located almost centrally and is elongated 4' by 1' along the galaxy's major axis. With his 13-inch f/5.6 telescope at 60x, Steve Coe saw this galaxy elongated in a 3:2 ratio with some central brightening and a mottled appearance. I counted 12 stars across the face, the brightest glowing at 12th magnitude on the northern end. While I was unable to discern any of the dark clouds or star clusters, the 13-inch easily showed two H II regions and a third, more difficult nebulous patch. The drawing shows the three H II regions, all at the galaxy's northern end. The easternmost, Hubble No. 14, "blinked" well with an O III filter and showed a round, uniform disk 15" across at 310x. Hubble No. 9, in the center, is brighter than No. 14, and shows some brightening at its center. Finally, Hubble No. 4 is the most difficult, a round, 30"-diameter diffuse patch around a tiny clump of stars, not responding at all to the O III filter.

IC 1613 in Cetus sits at a similar distance as NGC 6822. This irregular galaxy shows very little in the way of dust and few bright open clusters (although 25 quite small ones have been found). CCD images taken with the Kitt Peak 2.1-m telescope through an H-alpha filter (Hodge, Lee and Gurwell, 1990) have brought the number of H II regions to 77. Visually, IC 1613 is a fairly difficult object, showing the lack of contrast with the night sky so common in the Local Group galaxies. At a low power of 75x, it appears perfectly round, a uniform brightening of a poor star field. To make viewing more difficult, an 8th-magnitude star 10' to the northwest almost spoils the view. Most of the more prominent H II regions are in the northwest quadrant of the galaxy, but the 13-inch failed to show them.

Moving back toward the galactic plane, we find **IC 10** in Cassiopeia. This galaxy shows a high B-V value, being strongly reddened due to obscuration by our own Milky Way. IC 10 is positioned where a galaxy has no business showing up: only 3° from the galactic plane. Therefore, it is pretty difficult to observe, despite its close proximity. The 13-inch showed a faint, 4' by 3' mist against a bright background, elongated northwest-to-southeast. The star field here is incredibly rich and reminded me of the field around the beautiful edge-on galaxy in Andromeda, NGC 891. A 12th-magnitude star shines in front of its center with two other 13th-magnitude stars to the north, still in the small glow of the galaxy. Although the detail is not spectacular, this one exhibits that magnificent "three dimensional" effect of a galaxy forming a backdrop to a Milky Way starfield.

The autumn night sky contains six more Local Group irregulars. Surprisingly bright is **WLM**, named after astronomers Max Wolf, Knut Lundmark, and P.J. Melotte, who discovered it early in this century. P.J. Melotte (1926) commented on the striking similarity between this galaxy and NGC 6822. Its stars, of 18th magnitude, are easily resolved on plates, and it even contains one globular cluster. Don't be daunted by the low surface brightness given in the table as WLM was pretty easy in the 13-inch. It was elongated 9' by 4' north-south, and appeared uniform across most of this area. The outer l' around its periphery showed a rapid fall-off to the sky brightness. Three stars are easily seen superposed posed on the galaxy's face.

At a distance of nearly 1,750 kpc, the **Pegasus Dwarf** is truly at the edge of the Local Group, near its "zero velocity surface." It appears 8' by 3' in extent, elongated in p.a. 105°, and pretty faint overall but with some central brightening. There are eight bright stars across the face of the galaxy in what is otherwise a poor starfield. About 20' south is a chain of six stars in an arc ending at a 9th-magnitude star.

Local Group System 3 is a tough object, discovered in

Galaxies in the Local Group

Name	Other	Type	R.A. (2000.0)Dec.	Mag (V)	SB (V)	Size	Dist.	Con.
WLM		IB(s) IV-V	0h02.0m, -15°28'	11.0	14.9	10'.2 by 4'.2	960 kpc	Cet
IC 10		KBm?	0h20.4m, +59°18'	10.3	13.5	5'.1 by 4'.3	870	Cas
NGC 147		dE5 pec	0h33.2m, +48°31'	9.5	14.5	13' by 8'	610	Cas
And III		—	0h35.4m, +36°31'	—	—	4'.5 by 4'.0	—	And
NGC 185		dE3 pec	0h39.0m, +84°20'	9.2	14.3	11' by 10'	570	Cas
NGC 205	"M110"	E5 pec	0h41.3m, +41°41'	8.0	13.6	17' by 10'	760	And
NGC 221	M32	cE2	0h42.7m, +40°52	8.2	12.3	7'.6 by 5'.8	760	And
NGC 224	M31	SA(s)b 1-11	0h42.7m, +41°16'	3.5	13.4	178' by 63'	760	And
And I		dE3 pec?	0h45.7m, +38°00'	13.2	16.2	3'.5: by 2'.5:	—	And
SMC		SB(s)m pec	0h51.7m, -73°14'	2.3	13.8	4°.7 by 2°.6	60	Tuc
Sculptor	E351-G30	dE3 pec	1h00.0m, -33°42'	9.2	16.7:	28' by 23'	110	Scl
LGS a3	Pisces	—	1h03.8m, +21°53'	—	—	—	—	Psc
IC 1613	DDO 8	IAB(s)m V	1h05.1m, +2°08'	9.4	14.6	12' by 11'	730	Cet
And II		—	1h16.4m, +33°27'	<15		3'.5 by 3'.5	730	Psc
NGC 598	M 33	SA(s)cd II-III	1h33.9m, +30°39'	5.7	14.1	62' by 39'	1100	Tri
Formax	E356-G04	dE2	2h93.9m, -34°32'	9.0(B)	15.9(B)	12' by 10'	130	For
UGC-A86		—	3h59.9m, +67°08'	—	—	—	630	Cam
LMC		SB(s)m	5h19.7m, -68°57'	0.1	13.9	10°.8 by 9°.2	54	Dor
Carina	E206-G220	dE3	6h14.6m, -50°58'	20.4:	—	35' by 26'	85	Car
Leo A	Leo III	IBm V	9h59.4m, +30°45'	12.6	15.5	4'.9 by 3'.2	1600	Leo
Leo I	Regulus Sys	dE3	10h05.5m, +12°19'	10.1	15.0	10'.7 by 8'.3	230	Leo
Sextans		dE3	10h13.2m, -1°37'	11	20	90' by 65'	85	Sex
Leo II	Leo B	dE0 pec	11h13.5m, +22°10'	11.5	17.1	14' by 13'	230	Leo
GR 8	DDO 155	Im V	12h58.7m, +14°13'	14.4:	14.6:	1'.2 by 1'.1	1000	Vir
Ursa Minor	DDO 199	dE4	15h08.8m, +67°12'	<14	—	32' by 21'	67	Umi
Draco	DDO 208	dE0 pec	17h20.1m, 57°55'	<14	—	40' by 25'	75	Dra
Sag DIG	E594-G04	IB(s)m V	19h30.1m, -17°42'	—	—	3'.3 by 1'.8	—	Sgr
NGC 6822	Barnd's Gal.	IB(s)m IV-V	19h44.9m, -14°49'	8.6:	13.5:	10'.2 by 9'.5	620	Sgr
Aquarius	DDO 210	Im V	20h46.8m, -12°51'	14.7	15.4:	2'.1 by 1'.2	—	Aqr
IC 5152		IAB(s)m IV	22h06.1m, -51°17'	10.5	13.1	4'.9 by 2'.8	1500	Ind
Tucana		dE5	22h41.7m, -64°25'	15.0:	17.5:	5' by 2'.5	290	Tuc
Pegasus	DDO 216	Im V	23h28.6m, 14°45'	12.0	14.7	4'.6 by 3'.0	1700	Peg

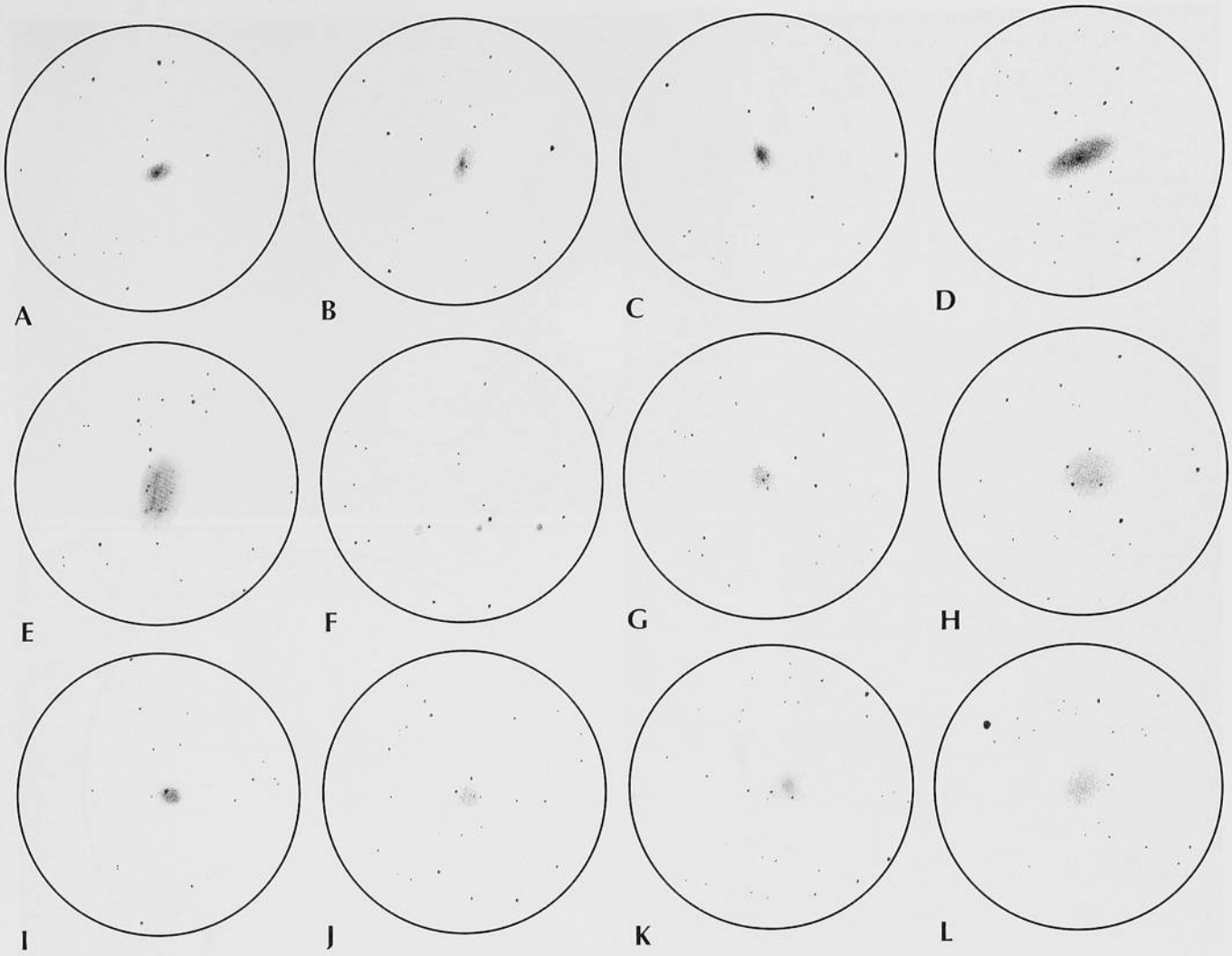
1978. The 13-inch showed a 4' diameter uniform haze which was visible about 50 percent of the time. Psi^2 Piscium must be kept out of the field of view to have any chance of seeing the galaxy. **The Aquarius Dwarf** (DDO 210) is extremely difficult, showing a round 2' glow which disappeared from view at any powers over 118x. A 10th-magnitude star is situated 5' north. Save **IC 5152** for a night at a low-latitude site. At a declination of -51°, it skims the creosote bushes even from southern Arizona sites. Surprisingly, it was quite easy, showing a 3' by 2' glow with an 8th-magnitude star embedded in its western end. With several attempts racked up, I had no success in seeing **SagDIG**, the Sagittarius Dwarf Irregular Galaxy with the 13-inch. However, Houston amateur Larry Mitchell and I were able to pick this one out at the 1991 Texas Star Party. His 24-inch telescope resolved about two dozen faint stars over a region 2' across. It should appear about 3' by 2', and may be viewable from a Southern Hemisphere site.

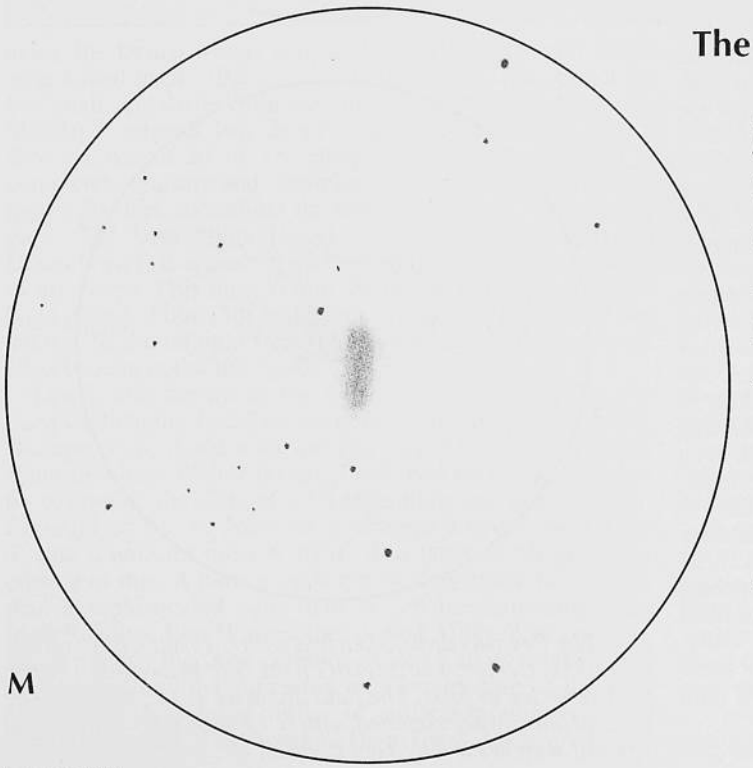
Yes, there are Local Group galaxies in the Spring sky. But with objects appearing in both Aquarius and Virgo, the prospects of any "Local Group marathons" are pretty bleak! **Leo A** is another very distant member of the group, at over 1500 kpc. In the 13-inch, I was able to detect a faint, round glow about 4' across surrounding five 14th-magnitude field stars. **GR 8** was originally thought to be a member of the Virgo Cluster, and was catalogued as such by Gibson Reaves (1956). Eleven years elapsed before its Local Group membership was confirmed (Hodge, 1967). It is one of the smallest irregular galaxies known, at 50 parsecs across, the size of an ordinary globular cluster. GR 8 is situated less than 10' west of the bright edge-on galaxy NGC 4866 which is a distraction at any magnification. The 13-inch working at 215x showed a 14th-magnitude star at its position with a very small glow extending northward from this star measuring maybe 1' by 0.5' at best. GR 8 was clearly visible in Larry Mitchell's 24-inch scope as a round glow, 2' across, with some central brightening. Closing out the irregulars, we find **UGC-A86.** This one was imaged in 1990 with the 5-meter Hale telescope. Based on photometry and the degree to which it was resolved, the distance is tentatively set around 600 kpc, well within the Local Group envelope. Several futile attempts with the 13-inch showed nothing at its position.

The Ellipticals

Until recently, the dwarf ellipticals of the Local Group had been referred to as "The Seven Dwarfs." The addition of two more in 1990 brings the total to nine. As these are nearby, a necessary condition for them to be seen at all, they typically appear quite large and of incredibly low surface brightness. Since many of these have a roughly spherical shape, they resemble globular clusters. But they are not simply glorified globulars, as they show a younger population of stars. The largest dwarf elliptical even has globulars of its own!

Harlow Shapley found a smudge of light on a Harvard 24-inch refractor plate in 1937. In order to confirm this object, he had to go back 30 years to a photograph taken with a 3-inch aperture camera. They obviously didn't have hypered Konica 1600 back then — the image was a 72 hour exposure! The object was referred to as the **Sculptor System.** This would be the first discovery of a Local Group dwarf elliptical. The Sculptor System covers an immense area of the sky being over 1° in diameter. The best one can hope to see is a





The View through the Eyepiece

A: M32 sketched with a 13-inch f/4.5 reflector at 165x. The field diameter is 30'. All sketches are by Tom Polakis.

B: NGC 147 sketched with a 13-inch f/4.5 reflector at 75x. The field diameter is 1°6'.

C: NGC 185 sketched with a 13-inch f/4.5 reflector at 75x.

D: NGC 205 sketched with a 13-inch f/4.5 reflector at 115x. The field diameter is 42'.

E: NGC 6822 sketched with a 13-inch f/4.5 reflector at 75x.

F: HII regions in NGC 6822 sketched with a 13-inch f/4.5 reflector at 215x. The field diameter is 23'.

G: IC 10 sketched with a 13-inch f/4.5 reflector at 75x.

H: IC 1613 sketched with a 13-inch f/4.5 reflector at 75x.

I: IC 5152 sketched with a 13-inch f/4.5 reflector at 115x.

J: Andromeda I sketched with a 13-inch f/4.5 reflector at 75x.

K: The Aquarius dwarf sketched with a 13-inch f/4.5 reflector at 75x.

L: Leo I sketched with a 13-inch f/4.5 reflector at 60x. The field diameter is 1°2'.

M: Wolf-Lundmark-Melotte (WLM) sketched with a 13-inch f/4.5 reflector at 75x.

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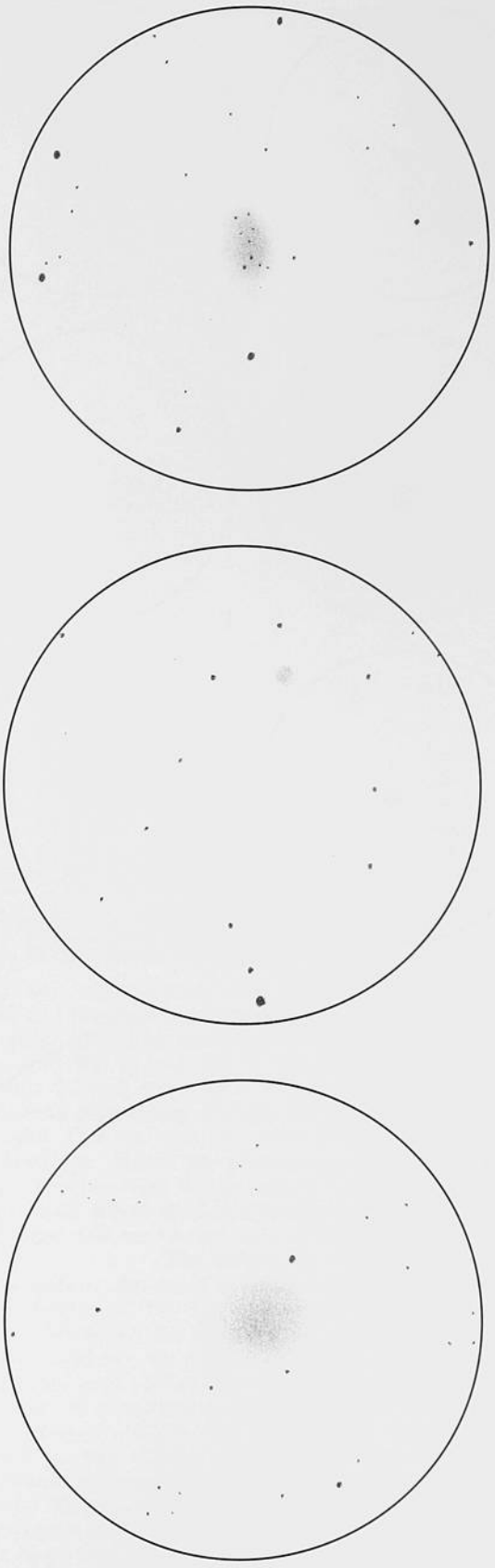
AJ = The Astronomical Journal
ApJ = The Astrophysical Journal
ApJS = The Astrophysical Journal Supplement Series
MNRAS = Monthly Notices of the Royal Astronomical Society
PASP = Publications of the Astronomical Society of the Pacific

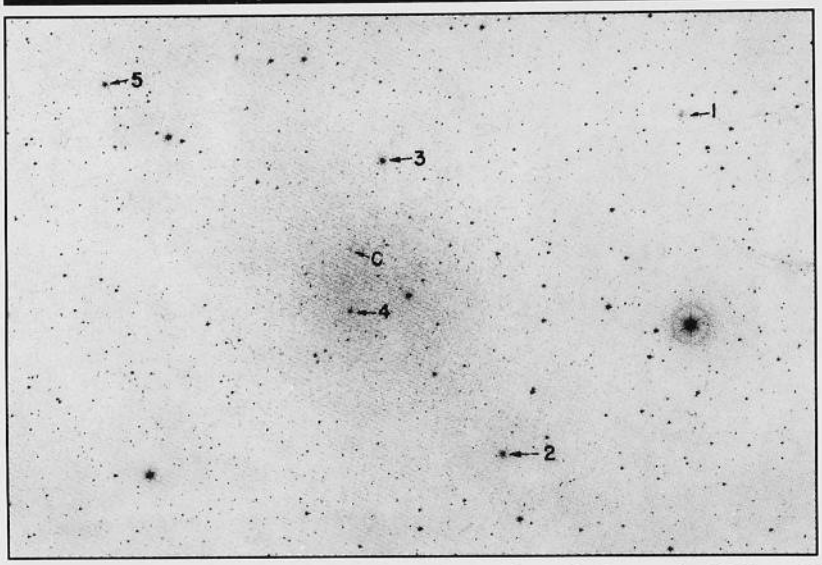
subtle glow just above the skyglow. After several failed attempts with my 13-inch, I tried using observing buddy Rich Walker's 8-inch f/5 with a 20mm eyepiece giving a field of view over 1.5° across. By rocking the tube, a sky brightening could just be seen over about a 1/2° diameter region. Similarly, Steve Coe saw it best with a 4 1/4-inch f/4 rich field scope and a 32mm eyepiece. Again, Southern Hemisphere observers are challenged to see this as it passes near their zenith.

Very soon after discovering "the system in Sculptor," the **Fornax System** was found. This turned out to be the most massive of the dwarf ellipticals, being home to five (maybe six) globular clusters (Hodge, 1961). The Fornax System requires similar observing techniques as used for the Sculptor System. Rich Walker's 8-inch again did the trick in showing it best, although the 13-inch showed traces at 75x. The glow is 20' in diameter and round with no brightening toward the center. A 9th-magnitude star, plotted on *Uranometria 2000.0*, is centered in the glow. Using this "central star" as a starting point, four of the five globular clusters can be observed, even if the galaxy itself cannot. Located north of the central star, No. 3 is bright enough to warrant a listing in the *New General Catalogue* as NGC 1049. It looks similar to a planetary nebula at 310x, being 20" in diameter with a bright center. No. 4 is one magnitude fainter than NGC 1049 and appears 10" in diameter with a pretty bright center. No. 2 is faint and large, 20" in diameter but of low surface brightness. Finally, globular No. 5 appears about 15" in diameter with some slight central brightening. Only globular No. 1 was too faint for the 13-inch.

Swinging far to the north shows a pair of large, similar gal-



Top: The Pegasus dwarf sketched with a 13-inch f/4.5 reflector at 75x. Center: The SagDIG field sketched with a 13-inch f/4.5 reflector at 310x. The field diameter is 15'. Bottom: The Ursa Minor dwarf sketched with a 13-inch f/4.5 reflector at 75x. All sketches are by Tom Polakis.



Left: Because of its proximity to Regulus and low surface brightness, Leo I is an extremely challenging galaxy for visual observers. Photo by Chris Schur (12.5-inch f/5 reflector, hypersensitized Tech Pan film, 60-minute exposure).

Below left: Globular clusters in the Fornax galaxy cluster. Photo courtesy Paul Hodge.

Below: IC 10 in Cassiopeia. Photo by Martin C. Germano (8-inch f/5 reflector, hypersensitized Tech Pan, 75-minute exposure).

axies, the **Draco Dwarf** and the **Ursa Minor Dwarf.** These were found in the 1950s on the *POSS* plates. They are close but small, and suffer from the same low surface brightness as Shapley's original two dwarf ellipticals. The Draco Dwarf shows a size of 20' by 15', elongated east-west at 75x. It is completely uniform and very elusive visually. A faint grouping of 20 stars appears on the southern edge of the galaxy's glow. The Ursa Minor Dwarf is slightly brighter than the Draco Dwarf. It appears round and only showed its central 5' in my scope. This must simply be the brightest portion of a huge galaxy. Four 13th-magnitude stars cover the face of the galaxy. Scattered light from two bright stars to the northeast must be kept out of the field.

Leo I, also known as the Regulus System, is one of the most challenging Local Group galaxies to photograph. Many attempts were made with the 200-inch telescope, including some in which Walter Baade (1950) had baffles installed to try to combat the glare of a 1st-magnitude star just 20' away. I found Leo I to be pretty easy, elongated east-to-west 8' by 6' with a uniform inner 6' by 4', then tapering off gradually outside of this. A narrow apparent field eyepiece fares better than a sophisticated wide-field design in eliminating glare from Regulus. **Leo II** is another distant Milky Way companion at roughly the same distance as Leo I, to its southwest. It appeared at low magnification as a brightening of the field measuring 15' across, similar in surface brightness to the Sculptor System. **The Sextans Dwarf** was discovered early in 1990 on UK Schmidt plates (Kwin *et al.*, 1990). This galaxy is considered to be at the limit of what can be detected on these plates, even though the resolved image extends to over 1 1/2°. I saw no sign of it in the 13-inch as it passed near the meridian.

Two new dwarf ellipticals have joined the club recently. **The Carina Dwarf** was found on UK Schmidt plates in 1975. It is much less populous but otherwise quite similar to the Sculptor and Fornax dwarfs. Brian Skiff saw nothing obvious at its position with his 6-inch refractor working at 50x while in Chile. Finally, as I was putting this article together, a new Local Group galaxy, the **Tucana Dwarf**, was announced on an IAU Circular card (Lavery, 1990). Its color-magnitude diagram indicates that at 290 kpc, it is well within the confines of the Local Group. Both the Carina Dwarf and Tucana Dwarf are too low to observe from the northern hemisphere, but *Deep Sky* welcomes observations from southern hemisphere readers.

A tour through the Local Group gave me more of what I try to grasp through amateur astronomy, a perspective on our locale in the universe. Here is the word "local" used in its broadest sense, and yet these objects do seem somehow close. By observing these extremely faint objects, we get more clues about the scale of the universe. □

Tom Polakis is a contributing editor of Deep Sky *who observes from dark sites near his home in Tempe, Arizona.*

Deep-Sky Magic returns to the Texas Star Party

by Robert Reeves

Looking back at the 1991 Texas Star Party, I saw the event as a study in contrasts as well as a revival of the deep-sky magic this event is noted for. Organized by the Southwest Region of the Astronomical League and held at Fort Davis, Texas, this year's Star Party redeemed itself after the two previous rain and lightning plagued gatherings. In a sense, the 1991 Texas Star Party actually suffered from an excess of clear skies, rendering dedicated observers into sleep-deprived zombies!

The overall laid-back mood of this year's 600 participants was in stark contrast to the intense and often aggressive mood spawned by poor weather last year. In the more relaxed atmosphere of TSP '91, astronomy came to the people as five consecutive clear nights was enough to mellow the most sky hungry observers.

This year's gathering also provided a contrast between shallow and deep sky observing advocates. While the fantastic dark west Texas skies are known as a galaxy hunters paradise, TSP '91 also hosted comet expert John Bortle, famed high resolution observer Stephen O'Meara, and three accomplished comet hunters, Howard Brewington, David Levy, and Brian Skiff, who have bagged 16 comets between them. This group represented a formidable pool of solar system observing talent in the midst of a predominantly deep-sky audience.

Most importantly, this year's Texas Star Party contrasted our generation of astronomers with the next as for the first time, children were in force at TSP. An issue frequently discussed with me at last year's TSP was the "aging" of the amateur astronomy community. As we baby boomers glanced over our shoulders, we saw no younger astronomers coming on board to carry on the faith. Looking at the nearly two dozen children playing among the ongoing TSP activities this year, I realized the void behind us would indeed be filled and the next generation of observers was among us already.

Like many other TSP attendees, I brought my six year old son, Jeffrey, to the star party for the first time. Lingering worries nagged me about how he would react to a week under the stars, but to my delight, he took to the sky like a veteran. Indeed, he refused to go to bed until he could see that the entire constellation Scorpius had risen above the mountains. Only then did he lay down, still insisting on a clear view of the stars. Tucking my son into bed, I realized the next generation of astronomers is in good hands.

A Week of Astronomy Activities

Because the Texas Star Party is set deep in the remote Davis Mountains of West Texas, most attendees spend the entire week at the ranch, making a vacation out of the event. The first several days allow free time to visit McDonald Observatory, two 85-foot radio telescopes, and the scenic Davis Mountains State Park, all located just a few minutes' drive from the TSP site.

Star party program activities began on Tuesday evening with an astronomical computing seminar hosted by the San Antonio Astronomical Association. Topics ranged from the deluge of astronomical data and images now available on CD-ROM disks to a colorful review of the powerful Dance Of The Planets program.

The real TSP magic began on Tuesday night, the first of five consecutive clear, dew-free nights. It is a testimony to the observers using the 200 telescopes present that no stray lights hindered other person's observations. The only exception was a very confused lightning bug that kept orbiting above the observing field, wondering why the hundreds of glowing LEDs would not answer his blinking mating call.

Clearly evident on the dark observing field was the new popularity in amateur astronomical electronics. A large fraction of telescopes were under some form of computer control, whether it be simple digital setting circles or computer remote controlled stepper motor slewing and tracking. Set up near my own telescope was a scene repeated at many locations. A table held several powerful PCs, each with their gently whirring hard drives recording the CCD images displayed across a bank of four red filtered CRT monitors. As natural and modern as this scene looked, I had to remind myself that here in the hands of amateurs under the Texas sky was more computing power than existed in all of NASA thirty years ago.

The exceptionally dark skies of West Texas fooled many city bound observers. Not used to the bright zodiacal light, many openly complained as late as 11 p.m., "When is twilight going to be over?" The brilliance of the zodiacal pyramid was emphasized to me when I entered my dark tent to blindly retrieve a midnight snack. When I exited, I was momentarily dazzled by the bright glow above the western horizon.

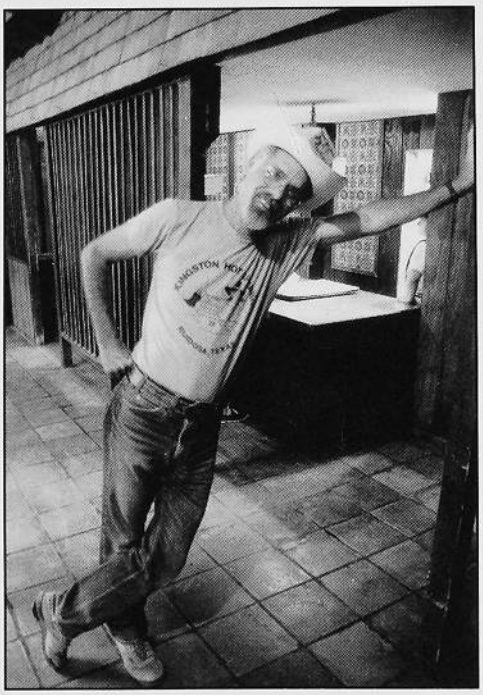
Planetary Legend Returns

Wednesday marked the beginning of daytime programs with talks ranging from Earth satellite observation to the geology of Venus. However, the highlight was the evening keynote speaker, Pluto discoverer Clyde Tombaugh. Having already fascinated TSP on two previous occasions with his Pluto stories, this year Clyde reviewed his professional accomplishments in the years after the discovery of Pluto, using a mixture of science and quick wit to keep the audience entranced. Following his talk, Clyde and author David Levy

Stars trail overhead as dozens of red flashlights illuminate the way for observers on the ground. Photo by Tom Polakis.

Left: TSP fixture Ed Boutwell of Birmingham, Alabama, supports the star party in m ore ways than one. All remaining photos in this article are by Dave Eicher.

Below: Star party organizers from Oklahoma and Texas pose under a hot midday Sun. Left-right: Joe Liddell, David Higgins, Ed Flaspoehler, Larry Beatty, Mike Dennis, Steve Coleman, and Bobby Braley, Jr.



The view from Dave's room at TSP 1991.

did a brisk business autographing his recently published biography, *Clyde Tombaugh: Discoverer of Pluto.*

During the Thursday programs, William Georgevich related the joys of observing in shirtsleeve comfort during subzero weather. He described how he successfully uses a flat glass portal in the dome slot of his heated observatory. In another notable program, accomplished amateur filmmaker Don Garland from the Fort Worth Museum of Science enthralled the audience with one of the best solar eclipse films I have ever seen. The combined degree of artistic license and astronomical realism provided viewers with a startling taste of the upcoming 1991 Mexico eclipse.

That evening, comet expert John Bortle presented a review of the great comets that have frightened, enchanted, and finally educated Earthbound observers over the centuries. Also on Thursday, Stephen O'Meara led a lengthy discussion about the magnitude limit of the human eye. O'Meara followed up that presentation with practical observing under the evening sky where he talked novice observers through detecting astonishingly dim stars with the naked eye. The degree of success varied from person to person as he lost my tired eyes at magnitude 6.5, but brought one young lady with exceptional vision down to magnitude 7.5. Later, he and Barbara Wilson, using her 20-inch f/4 telescope and charts showing faint limiting magnitudes, reached an amazing visual magnitude of 18.6.

Farewell to a Cosmic Friend

Barbara's 20-inch scope was the site of an unusual ritual later that evening. Comet discoverer David Levy had used that same telescope at last year's Texas Star Party to confirm the discovery of Comet 1990c. This year David and his friends used the 20-incher to bid final farewell to Comet Levy 1990c, still ever so faintly visible after a full year.

By Thursday night the crescent Moon had crept into the evening sky and provided a welcome diversion from nonstop deep-sky observing by forming a beautiful conjunction with Venus and Jupiter. The sheer light gathering power of the huge Dobsonians present was evident as Ed Boutwell projected a bright, detailed two-foot diameter lunar image from the eyepiece of his 25-inch telescope.

Proving that amateur instruments have not yet reached the limits of what they can see, Stephen O'Meara introduced Texas observers to a gravitational lens. Easily seen in the 20- and 25-inch telescopes, the 17th-magnitude object is a quasar some 9 billion light-years distant that appears split into two images by the gravitational field of a foreground galaxy. TSP observers who took time to view this wonder in Ursa Major joined a select handful of people who have visually seen such an object. Observers who wish to try their eyepiece on this gravitational lens will find it listed as 0957+561A/B on Chart 45 of *Uranometria 2000.0*. It is located just north of the magnitude 11.4 galaxy NGC 3079.

As the clear nights continued, Florida's Tom Clark from Tectron Telescopes openly wished for clouds so he could get some sleep with a clear conscience. Tom was typical of many large Dobsonian owners at this year's TSP. They were proud of their large instruments and anxious to show others the magnificence of the universe as seen through their huge telescopes.

Indeed, the availability of large aperture instruments and the willingness of their owners to share them led to a new experience for me this year. Although I set up my own telescope for the first time in 10 years of TSP attendance, I never once looked through it. After all, who could resist the lure of observing all week through a host of instruments 20 inches or larger in aperture?

Another Floridian, Tippy D'Auria, organizer of the Winter Star Party, also attended TSP '91 upon my urging. D'Auria put the dark Texas skies to good use by commandeering a large Dobsonian and demonstrating the prototype 2" Panoptic 35mm focal length eyepiece given him by TeleVue at the star party.

After becoming jaded by the views offered by modern eyepiece designs, Tippy's Panoptic eyepiece really got my attention. The giant leap in image contrast and clarity provided by the Panoptic gave familiar deep-sky views almost an "image processed" look. Omega Centauri, a TSP showpiece object, no longer looked like a lump of rice pudding. Instead, the magnificent cluster looked like it had holes torn in its surface as the added contrast provided by the Panoptic eyepiece al-

lowed detection of details I had never seen before. After installing a UHC filter and turning this show stopping eyepiece toward the Veil Nebula, the streamers of NCG 6960 and NGC 6992 looked like jet airplane contrails.

Two things happened to me while using Tippy's Panoptic eyepiece. Early in the evening, while viewing Omega Centauri, a meteor flashed through the field of view. Later, just before Omega set, I returned to that object and again, a meteor blazed through the field of view. The TSP magic continued.

Who Says this has to be Serious?

On a lighter note, the clear skies throughout the week prevented the resolution of a battle that developed under the cloudy skies of last year's TSP between the Houston and Oklahoma City astronomy clubs. When clouds obliterated the skies, frustrated observers turned huge Dobsonians into light cannons for a notorious round of 1990 TSP laser cannon wars. Vowing a resolution of the battle, each club spent the past year developing the reputedly awesome "Stealth Nagler" and the dreaded "Death Nagler." However, clear skies this year averted a showdown and both sides retreated back to their secret laboratories for further research and development.

Friday's daytime activities focused on two things, catching up on much needed rest and the annual meeting of the Southwestern Region of the Astronomical League. As TSP '91 neared its final hours and we lounged in the cool lobby of the Prude dining hall, activity near the cable television set showed the star party was divided between two factions, those who were hooked on CNN and those who avoided it at all costs.

Part of the uniqueness of the Texas Star Party comes from the diversity of activities. While observing under the dark West Texas skies is a major attraction, 24 entries in the amateur telescope making exhibition displayed many new innovations in the fabrication of astronomical equipment. Additionally, dozens of high quality astrophotography contest entries showed no slacking of interest in that field.

Clear blue skies and the hot Texas sun combined to make two other spots very popular during this year's star party. The excellent covered swimming pool and the newly opened ice cream shop quickly became crowded favorites for those seeking to relax after five nights of observing.

The shallow sky program pattern set so far was broken Friday night. Janet Mattei, director of the AAVSO, delivered a fascinating talk detailing how amateur observers act as scouts for orbiting observatory satellites. Since the observing time of orbiting ultraviolet, gamma-ray, and x-ray observatories is severely limited, the crucial role of telling these satellites when to point toward active cataclismic variable stars falls on amateur observations coordinated through the AAVSO. Mattei showed how these backyard observations by amateurs can profoundly affect the progress of astronomical research.

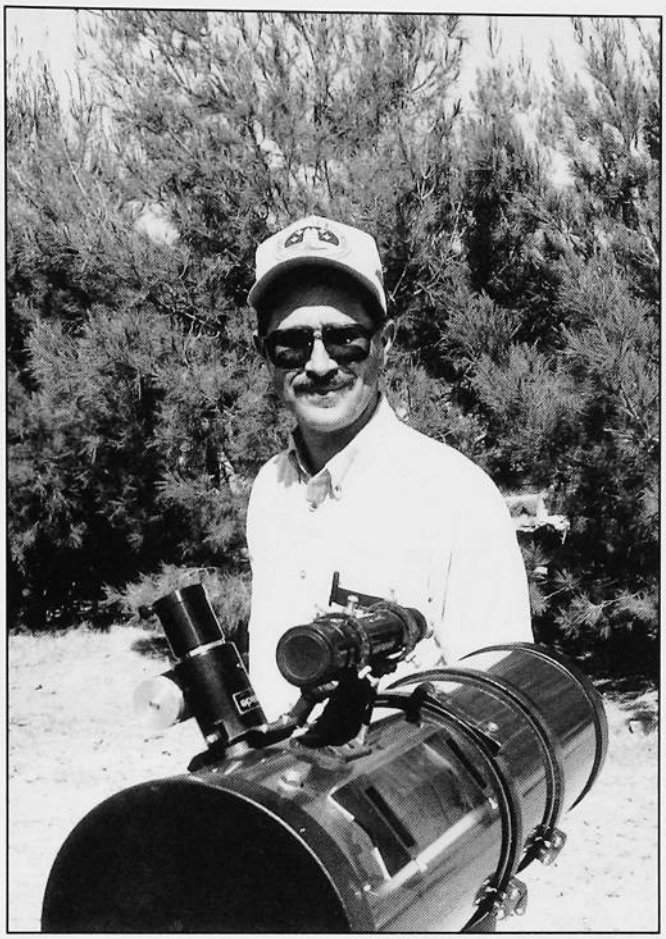
TSP Goes International

The appeal and magic of the Texas Star Party reached overseas again this year with astronomers jetting in from as far away as the United Kingdom. Brazil's Helga Zmuck declared that TSP is addictive as she returned for her third consecutive year. Helga nonchalantly noted to a salivating North American audience that the Southern Cross and Magellanic Clouds were showpiece objects as viewed from her apartment door, but showed unbridled enthusiasm at actually seeing Polaris. It just goes to show that everything is relative.

By Friday night the clear sky had become so commonplace that no one payed any attention to the weather satellite images received directly at TSP via satellite receivers. Instead, attention was riveted on another formidable bank of electronics set up by the Collins Amateur Radio Club.

Expanding TSP into an international event was accomplished by an on-site 10 meter HAM radio link which contacted 750 radio operators in 44 countries on all continents. Using a 55-foot antenna, a 1,000 watt transmitter, and the call sign K5GH (Galaxy Hunters), TSP broadcast voice and slow-scan television images of TSP activities to receivers all over the world.

The high point of the transmissions came when TSP was linked for 12 hours with an Australian star party hosted by the New South Wales Astronomical Society. Local observers Steve Coleman (WB4GHY), Larry Slay (K5WUL), George Huling (K5GH), and Clyde Heath (KA5JFH), main-

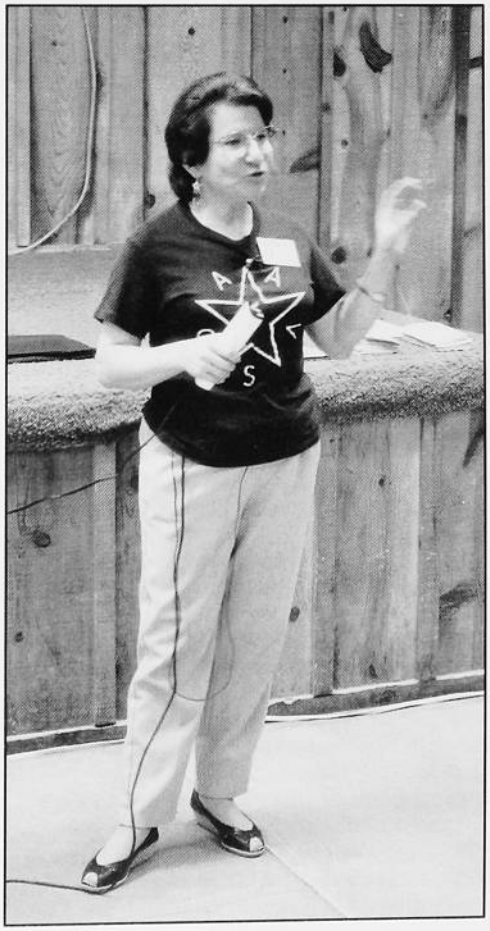


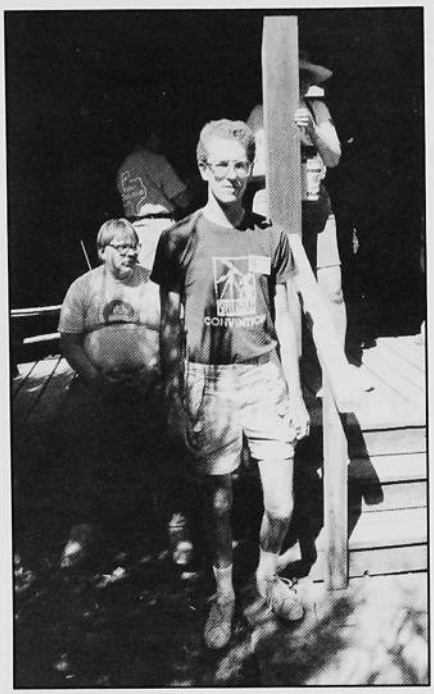
Left: David Higgins of Krebs, Oklahoma, long-time contributing editor of Deep Sky *and a frequent contributor to ASTRONOMY, checks out the TSP swap meet.*

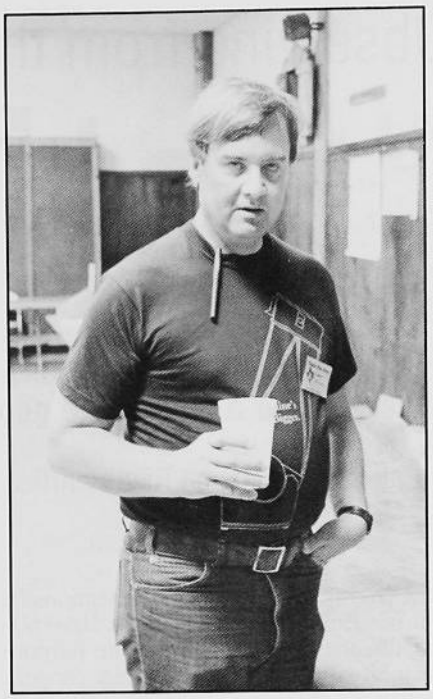
Below: The University of Alabama's Jack Sulentic, Houston's Barbara Wilson, and Brian Skiff of Lowell Observatory relax before Sulentic's acclaimed talk on galaxies and quasars with discordant redshifts.

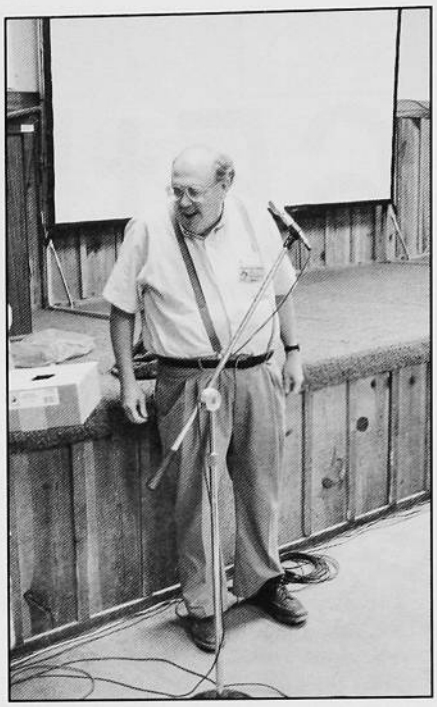
Bottom: Mike Dennis, a member of the Oklahoma City club, presides over the Astronomical League Southwest Regional business meeting.

Bottom left: Janet Mattei, director of the AAVSO, describes ongoing work in variable star observing.









Above left: Deep Sky *contributing editor Tom Polakis of Tempe, Arizona, author of this issue's lead feature, searches for shade after a night of observing.*

Above center: Planetary nebula observer Larry Mitchell of Houston enjoys an afternoon session and prepares for the night ahead.

Above right: In wehat has become TSP tradition, Al Bowen demonstrates his electric wit during the two-session "Great Texas Giveaway."

Left: The crowd at TSP on Saturday night is exhausted from a week of clear skies, and ready to head home in the morning.

tained a continuous contact with Sydney, Australia astronomer Chris Mlynarik (VK2CMK). The Australians, set up at a remote wilderness site, had to siphon gasoline from their cars to fuel generators to maintain contact.

Lengthy and enlightening intercontinental conversations were held exchanging observational notes about the gems of both the northern and southern skies. The Australians showed they were more than able to keep up with their American observing companions when Chris described in detail faint southern objects visible "with extreme averted imagination."

WSP's Tippy D'Auria amused and educated Saturday lecture attendees with his now infamous presentation "A New Way to Measure Astronomical Distances." In a nutshell, Tippy used toilet paper to define the size of the solar system at one sheet per million miles. The enormity of our own cosmic neighborhood becomes abundantly clear when four rolls of toilet paper are reeled several times around the room .

The highlight of Saturday's daytime presentations was a forum on comets featuring Bortle, Brewington, Levy, and Skiff. Titled "We're After Tail!," the forum presented personal views on comet hunting techniques from some of the leaders in that field. With a rich harvest of 16 comets between them, the four observers conveyed the idea that with comet hunting, the telescope used is less important than the persistence of the user.

Program activities ended Saturday night as keynote speaker Jack Sulentic, a professional astronomer with an interest in discordant redshift galaxy and quasar pairs, presented opposing arguments about the controversy over the true distances of quasistellar objects as indicated by their redshifts. Sulentic's presentation emphasized that as much as we think we know about the universe, there are areas still full of mystery.

The 1991 Texas Star Party ranks as the most relaxed and easy going TSP so far. As observers made the rounds on Saturday night to bid their farewells, the major complaint heard was "Too much clear sky, not enough sleep!" I did hear one anonymous voice boom out in the darkness to remind me that we are still serious about our astronomy. Said the disembodied voice, ". . . and God created the light . . . and then he created the astronomers to bitch about it!"

The 1992 Texas Star Party will be held at the Prude Ranch between April 26 and May 2, 1992. Make your plans now to join in the magic. □

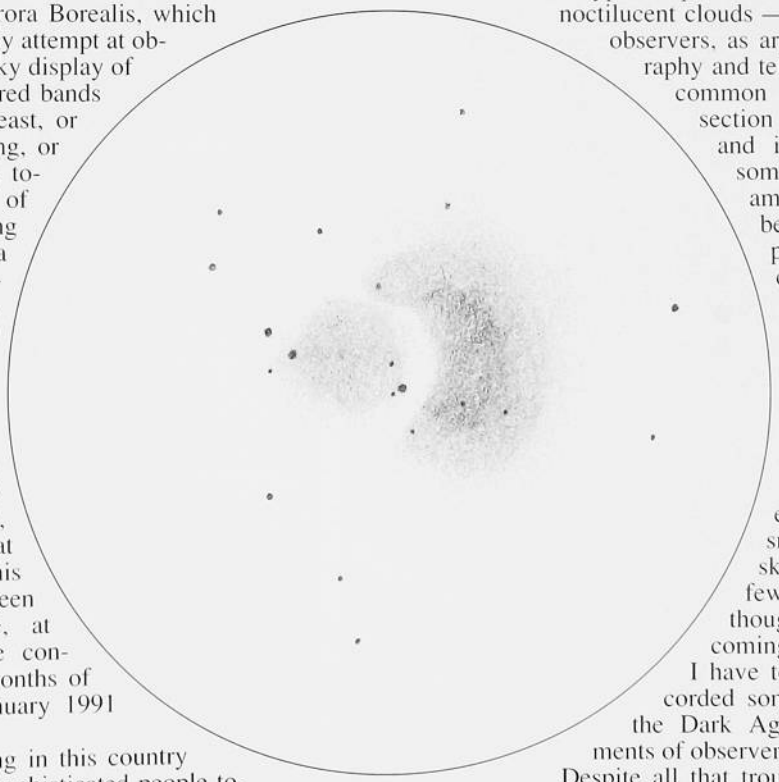
Robert Reeves has attended many Texas Star Parties and is a member of the support group, managing the astrophotography contest and and group photograph. He is a contributing editor of Deep Sky.

Observing from the 65th Latitude

Join two Finnish observers for a look at the good ol' Northern sky.

by Petteri Rajanen and Riku Henriksson

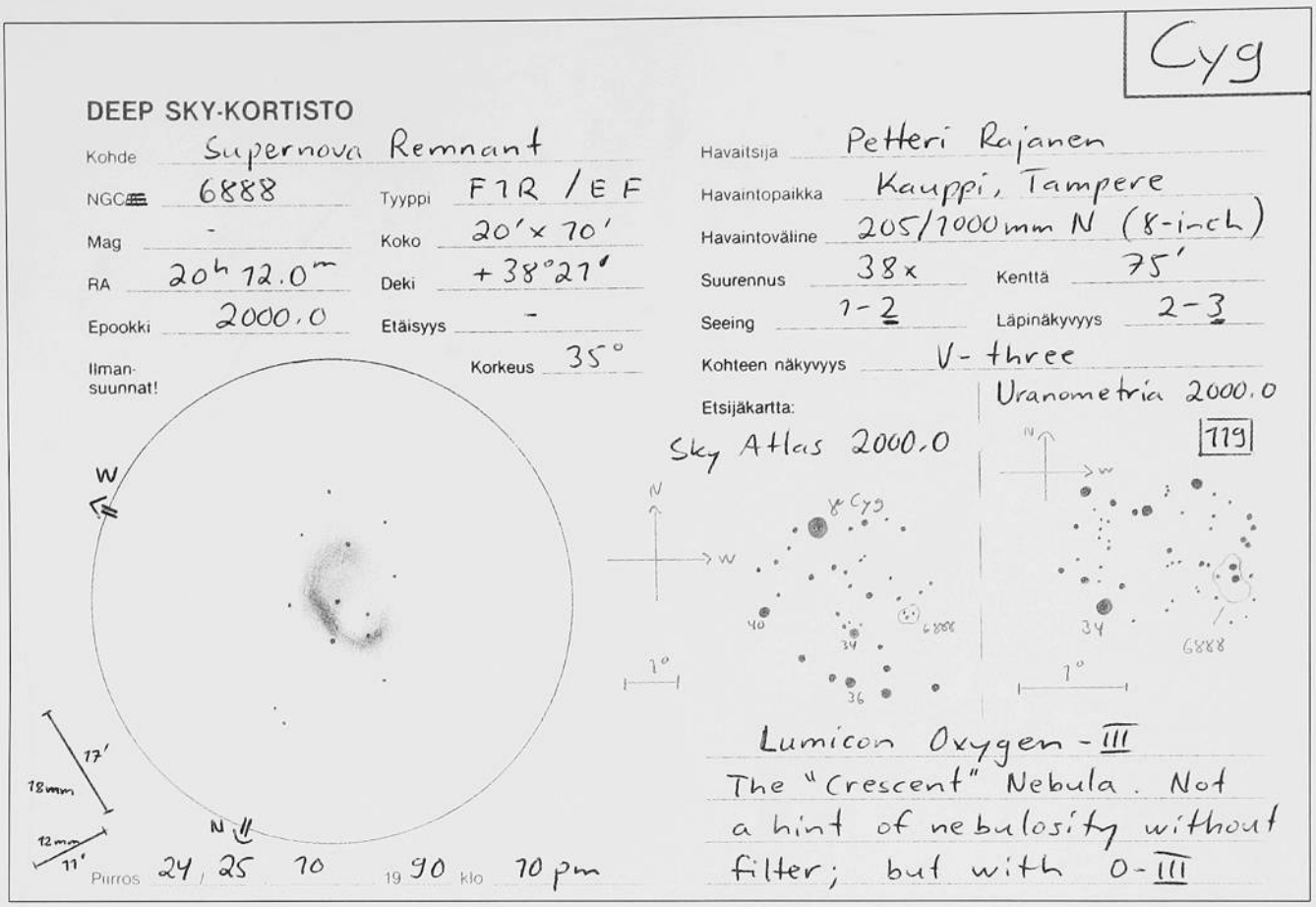
I (Petteri) am writing to you from the last God-forbidden-place still intact in Europe — Finland, that is. But with all seriousness, folks, this country is not actually the seventh heaven for deep-sky observers — it can be a bit cold during winter times and many other difficulties affecting observers exist. For example, the nights are far from dark because the snow efficiently reflects stray light up to the sky, making the sky more luminous than it is in most locations. Not to mention the notorius Aurora Borealis, which enjoyably extinguishes any attempt at observing. Imagine an all-sky display of bright violet, green, and red bands sweeping from west to east, or long, shiny rays extending, or more accurately flaming, toward the zenith. Plus, of course, some fast-pulsating patches topped with a striking and majestic corona. A magnificent, breathtaking sight to someone else, but to a deep-sky observer a dreaded curse. The spring of 1990 serves as a good example. Almost every clear night, with one to two exceptions, were jammed with that green goo. Luckily, this spring and winter have been much more observable, at least where aurorae are concerned. But the entire months of December 1990 and January 1991 were overcast.



The one and only thing in this country which bounds the more sophisticated people together and drags them out of the masses is the Ursa Astronomical Association. Well, maybe it's not *that* important. But the group has some 5,600 members (bear in mind that the whole population of the country is only 5 million) and possesses more or less a monopoly in popularizing astronomy. The majority of members are young people, usually from southern Finland. Ursa publishes the four-color magazine *Tahdet ja Avaruus* (Stars and Space) six times a year; it is directed to all members. The second magazine from the club is also a bimonthly, *Ursa Minor*. Almost all of Ursa's sixteen sections have their own column in this report, which averages 50 to 60 pages. I am the editor of the deep-sky column. The purpose is to gather and handle all observations and direct cooperation between observers, with some sort of observing programs.

The number of true deep-sky observers is small — only a handful. The conditions tend to discourage such observing, and other types of phenomena — especially halo and noctilucent clouds — are very popular among observers, as are variables. Astrophotography and telescope making are rather common activities, too. The halo section is the best in the world, and its members have made some famous discoveries among rare, or better still, before non-existent, halo phenomena. This fame causes new persons joining the ranks to funnel into these sections because they then belong to the "world elite." Besides, who would be such a dummy to sit outside in -22° Fahrenheit when the sky is illuminated with aurorae or by snow reflection, and try to sketch something? Well, a few daring men still exist, although they are very nearly coming to extinction. But okay, I have to admit that we have recorded some sort of progress since the Dark Ages, and the accomplishments of observers are slightly increasing.

Despite all that trouble, we are able to push ourselves into new objectives. Along with my old colleague, Riku Henriksson, I made an observing trip to the Canary Islands during the summer of 1989. Two weeks of steady sketching in Sagittarius and Scorpius ensued, with an 8-inch Dobsonian. That part of sky is invisible in Finland, so we didn't even have all the Messier objects visible, but now we have seen them. Other favorites included Omega Centauri and Barnard's Galaxy. The adventures go on. In July 1991 we will be in Mexico, observing southern objects and we might even catch a glimpse of eclipse, if any energy is still



left (and, by the way, visit Miami and New York).

The Finnish deep-sky branch is more or less conservative: black-on-white sketches made with rather small instruments. I use black cardboard and white pencil on faint objects, but normally on open clusters or bright planetaries I prefer the section's official form — an A5-size white cardboard with an 8cm circle. In the form are certain places for data on the object, conditions, instrument and eyepiece used, and a description. In addition to transparency and seeing I have included space for a description of "visuality," which gives a good idea what an object looks like in certain weather and instruments. The visuality is classed 1-5, where 1 means a bright object that is slightly better seen with averted than straight vision. The figure 5 is in the other extreme — a 5-object can be seen from time to time blinking with averted vision. I have heard that a similar classification system has been used in the States, or is it still operational?

The filters are another thing quite new around here. Not counting me, only one person in the country has them — our section leader Risto Heikkila. Of course, it is difficult to acquire those darn things because they must be ordered from the States, but that's only an excuse. The information about their value in Finnish skies just hasn't spread. Besides only three people here subscribe to *Deep Sky*. Therefore, we are just catching on to certain other things. For example, the use of high magnifications is not acknowledged — everyone uses low power. And I doubt many have heard about UGC galaxies or clusters of galaxies.

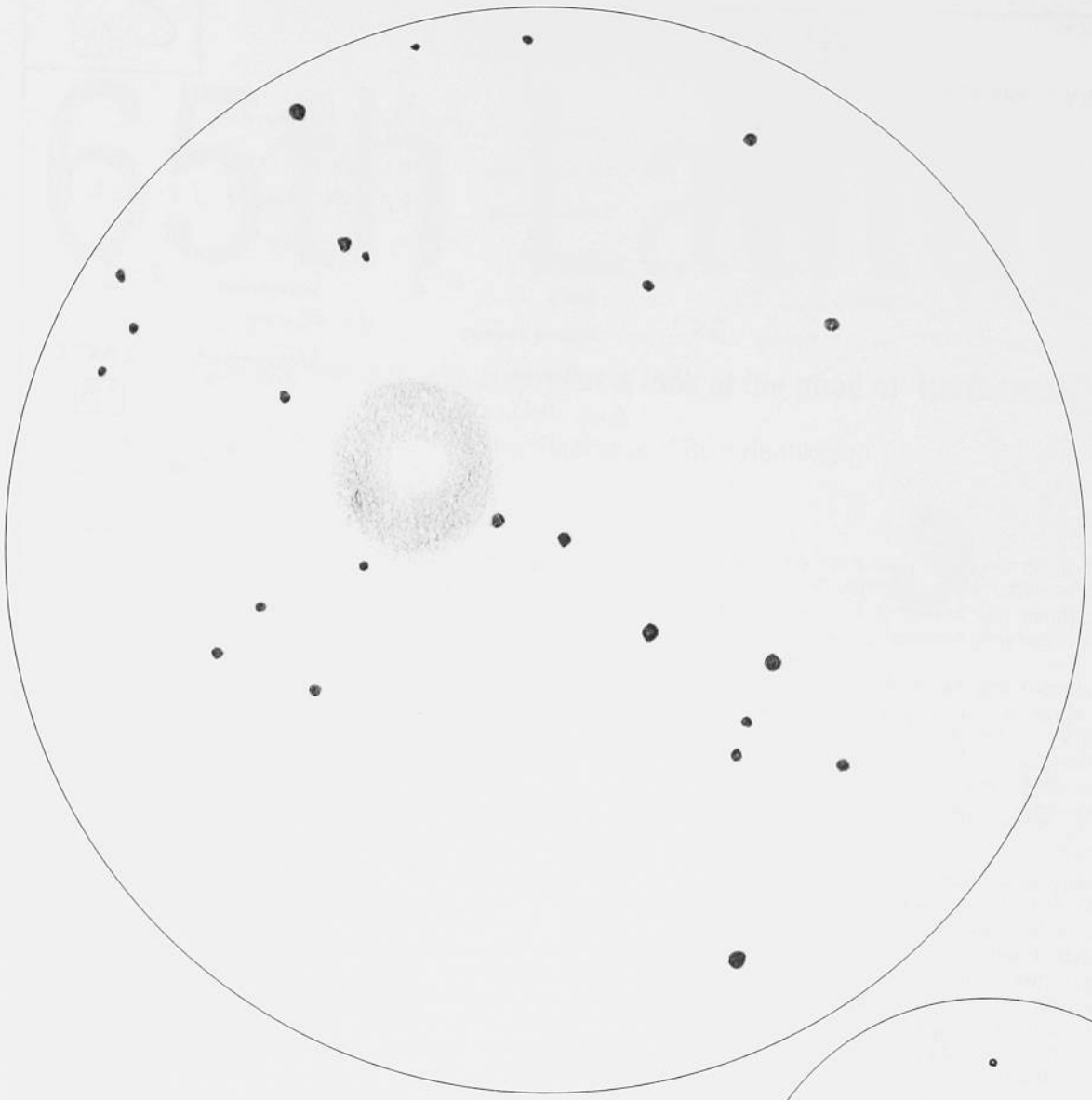
I live in the northern Finland, or more accurately, in southern Lapland, right next to the Swedish border — the place is called Simo, Filpus. It is countryside, in the bushes if you like. It's dark during autumns, which is also the time when aururae are very low in the north and do not bother us much. The only major setback of the site is the 65th latitude, which allows objects only above -25° declination (in practice -20°) to be seen. I am a backyard observer, and I set up my 8-inch f/5 Dobsonian in a special mount that can drive it if necessary. Usually I don't use it, but track with hands even at high magnifications. This season I moved my observing site to Tampere in southern Finland, and now I observe from the top of the city's reservoir, where the local association has facilities. The light pollution is ample, and the city is situated toward the south. Nevertheless, with nebula filters and proper dark adaptation in the dome, I have managed to see the Horsehead Nebula, and later with colleague Henriksson, the California. The filters also help greatly with eliminating moonlight. I was able to pick out a 14th-magnitude planetary with an O III filter during a Full Moon using my 8-inch.

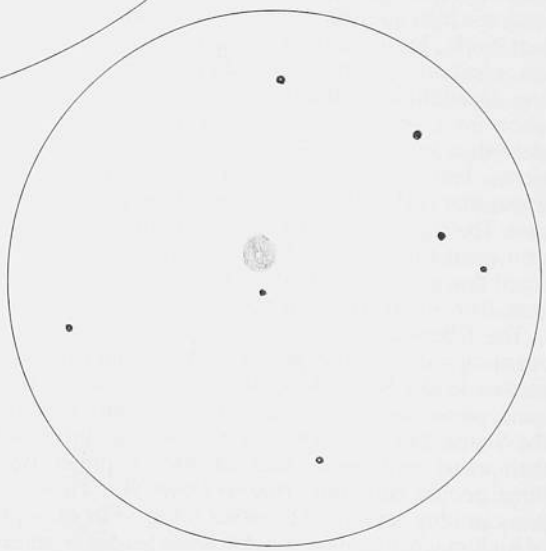
Something we can't get around so easily is the weather. We expect 20-25 clear nights per season and this includes all those nights when transparency reaches only the value 3 or even less. (Both seeing and transparency scales are based on Antoniadi rating, with 1 as the best [excellent] and 5 the worst [more or less cloudy].) There are only few very good nights, so observing nebulae and galaxies is a challenge. When transparency reaches 2 or even better, it is nebula time. When it's below 3 come the galaxies. Between 3 and 4 I opt for open clusters; and they form the majority of my sketches.

I greatly enjoy making drawings and think about the objects I have sketched in great detail. I think that the planetary NGC 1514 is one of the best I've ever seen — brightenings, dark patches and a double ring, it's a real thrill. Furthermore, the central star is very bright. Without the UHC filter only the star was visible — it didn't even look fuzzy. But with a UHC at 133x the nebula appeared clear and large, with com-

Opposite page: The emission nebula NGC 281 sketched by Petteri Rajanen with an 8-inch scope at 38x.

Above: One of Petteri's entire observing forms, showing the supernova remnant NGC 6888 in Cygnus.





Above: Planetary nebula NGC 6781 sketched by Riku Henriksson with a 10-inch reflector at 155x.

Right: Planetary nebula NGC 7662 sketched by Riku Henriksson with an 11-inch reflector at 300x.

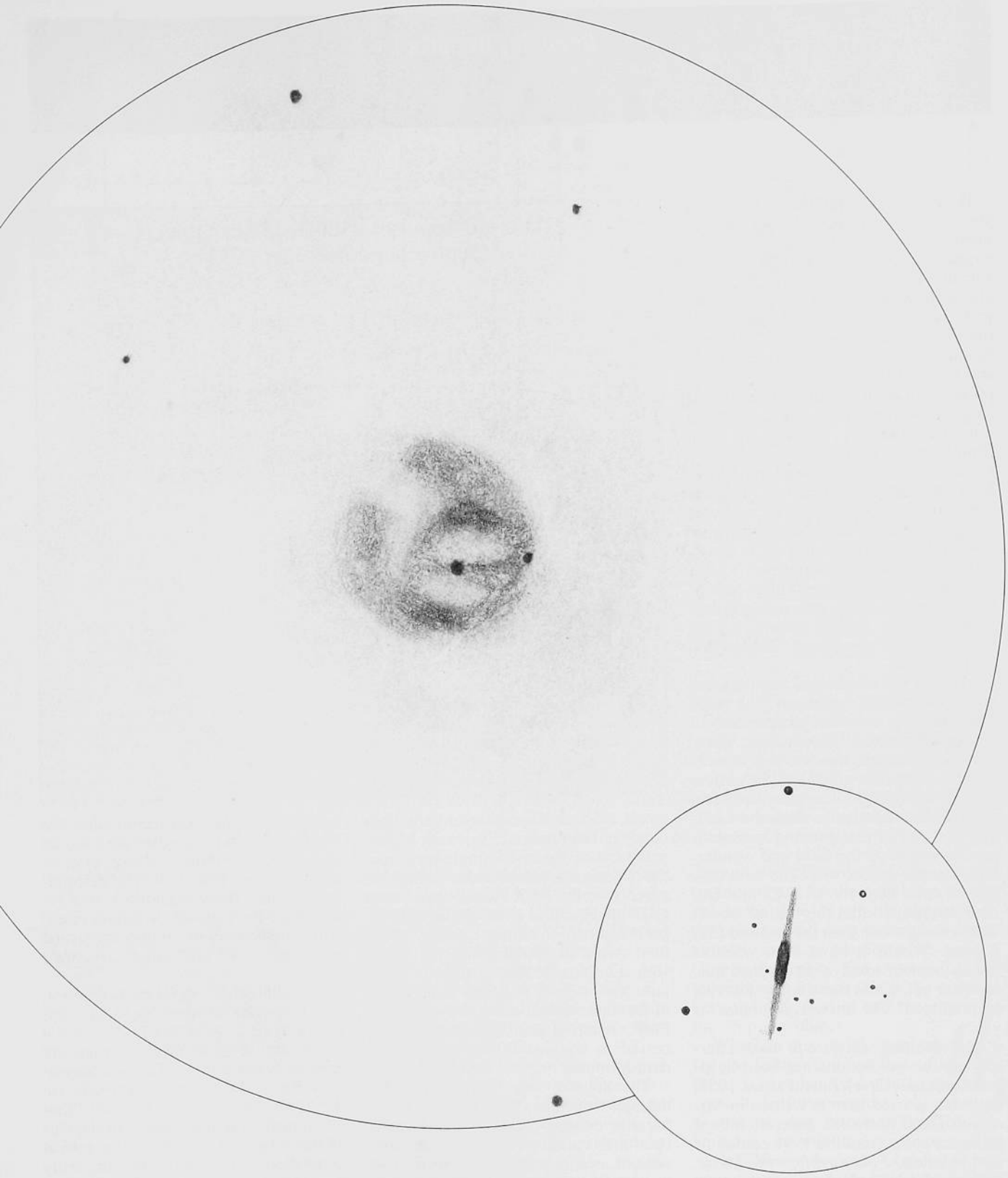
Opposite page, left: Planetary nebula NGC 1514 sketched by Petteri Rajanen with an 8-inch reflector at 133x.

Opposite page, right: Galaxy NGC 5907 sketched by Riku Henriksson with an 8-inch reflector at 96x.

plex and broken structure.

The Crescent Nebula (NGC 6888), a supernova remnant, is another not-able-to-find-without-filter nebulosity. At first not a hint of a nebulosity appeared in the field, but with the O III it was immediately visible at 38x. On the north side this object is a sharp, bright arc; in the middle of the crescent we see some gloom, a dark patch. It is a thrilling sight, indeed — and without the filter offers the best view at 38x.

Riku's sketches include the galaxy NGC 5907 in Draco plus the planetaries NGC 7662 in Andromeda and NGC 6781 in Aquila. He describes NGC 6781 as a "big M56," a round nebulosity with no central star and a hole in the middle. NGC 7662 is a bluish nebulosity, a round disk. It is a striking object. I have always liked NGC 5907, this needle-thin object,



like Riku has. He notes: "Absolutely magnificent, even striking, exactly edge-on. The thinnest galaxy I've ever seen. The bulge is a mere central brightening."

Those are only a few of the vast number of fascinating objects. There are many more that have produced some sort of joy when found and obeserved. NGC 1, the very first, is one; M83, the beautiful barred spiral with three arms, another. And that trip to Grand Canary is still a highlight in my career. But maybe Mexico will change that. □

Riku Henriksson and Petteri Rajanen are two of Europe's most active (and colorful) deep-sky observers.

Deep Sky Reports

Asteroid Appulses with Deep-Sky Objects

by Paul L. Sventek

How well do you really know the star fields in and around your favorite deep-sky objects? Do you think you would be able to recognize an "extra" star-like object in front of an open star cluster or near an extended nebular object? Have you ever watched an asteroid move hour-by-hour, or in rare cases minute-by-minute, through congested star fields? Dozens of these asteroid appulses with deep-sky objects are occurring all the time, but unfortunately the asteroids involved are usually faint (fainter than 13.0 visual magnitude). However, several times each month, an asteroid 12th magnitude or brighter passes in front of or near by many of the popular deep-sky objects. Whether you would like to take this on as an observing or photographic project to test or hone your observing skills, some of the potentially best asteroid appulses with deep-sky objects coming up for the last several months of 1991 are discussed below.

My interest in asteroid appulses began by accident on March 31, 1983, when making a routine observation of the variable star U Geminorum. There are four 12th-magnitude stars near U Gem, and on that night in 1983, there was an 11th-magnitude star-like object only several arcminutes from the variable. The rest of that evening was occupied in watching the field and wondering what the object was. The next day, April Fool's Day, the IAU Central Bureau determined that the "extra" object was nothing more than the asteroid (52) Europa. Would it have been possible for an amateur to have determined this, or better yet, could these sorts of events be predicted? The answer, of course, is yes.

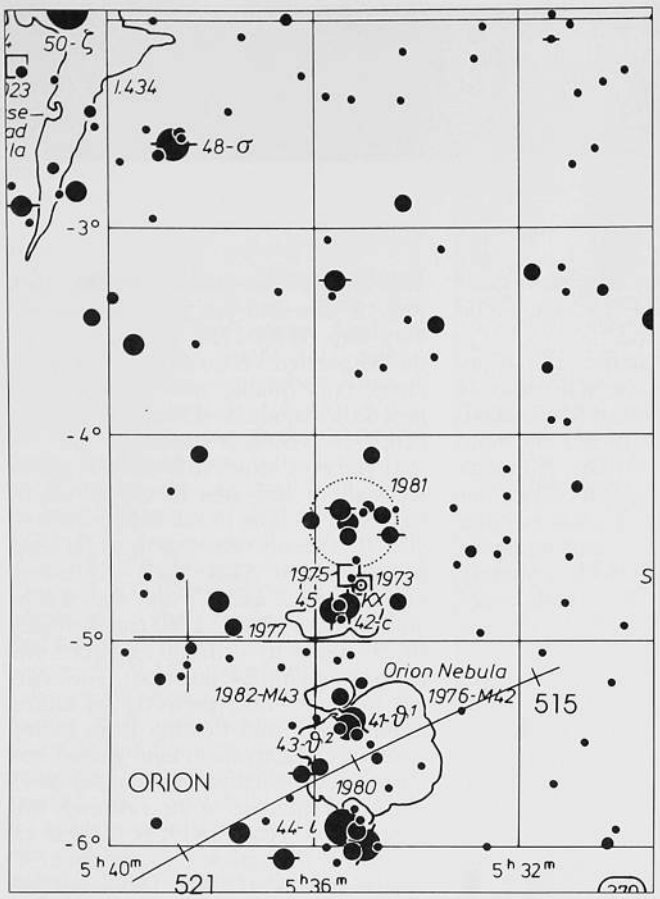
The resulting software to make asteroid appulse predictions has been in almost constant development since 1983, but what is used here is written in Microsoft QuickBasic 4.5. Asteroid orbital elements come from the 1991 edition of the Russian *Ephemerides of Minor Planets* (1991 *EMP*). Because the software uses single-precision, unavoidable rounding sometimes occurs in the last significant digit of some of the orbital element values. However, the overall accuracy of the calculate ephemerides still agree very well with those given in the *EMP*. The *EMP* ephemerides are published to an accuracy of ±9 arcseconds of Right Ascension and ±6 arcseconds of Declination. Even with Microsoft's Quick-Basic 4.5 single-precision, the calculated ephemerides used here agree with the *EMP* (when comparison *EMP* ephemerides are available to compare against) to almost always better than twice the published *EMP* precision. Equinox 1950.0 is used to compute the asteroid positions conforming to the same epoch used in the Russian *EMP*. Asteroid positions are then precessed to equinox 2000.0 using standard formulae.

The appulse search for September through November 1991 uses the entire Messier catalog plus 133 non-Messier open star clusters (visible during convenient evening hours) gleaned from the Arizona Database. If there is interest among *Deep Sky* readers in observing these asteroid appulses, the search could be opened up to many more objects. For the asteroids, the brightest 302 are selected according to the following selection scheme: The first 100 numbered asteroids are used without regard to brightness. The remaining 202 have mean opposition magnitudes (the B(a,0) magnitudes used in the Russian *Ephemerides of Minor Planets* prior to 1988) brighter than 13.4. The calculated asteroid visual magnitudes, however, do use the currently accepted calculation method involving absolute visual magnitude "H" and slope parameter "G."

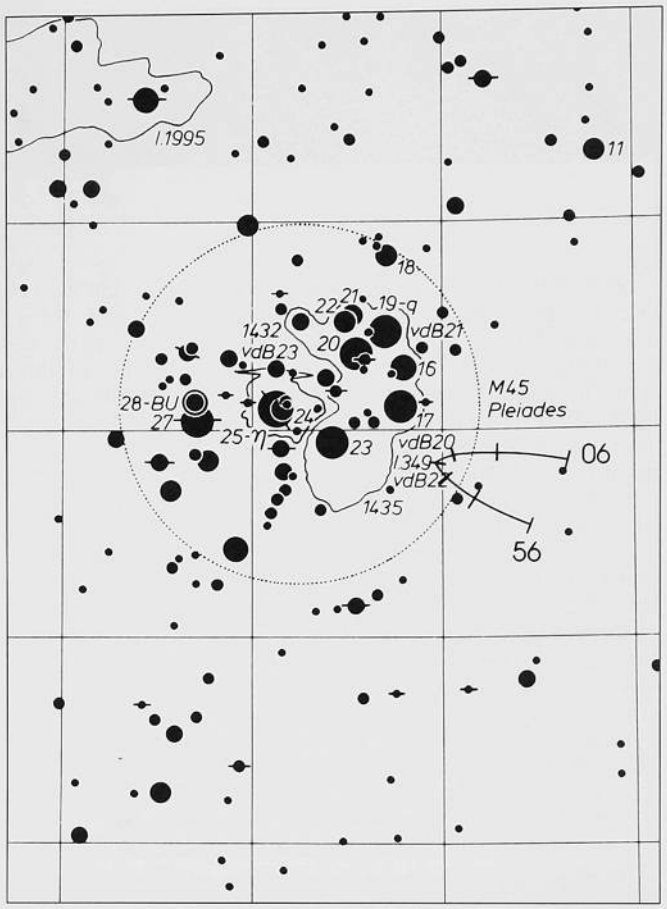
In making these appulse calculations, one thing that becomes immediately apparent is just what kind of celestial gymnastics some of these asteroids are capable of performing. The vast majority of the 4,265 numbered asteroids (in the 1991 *Ephemerides of Minor Planets*) remain within a handful of degrees of the ecliptic due to their low orbital inclinations. However, there are truly remarkable exceptions to this rule, one being the asteroid (2) Pallas. The 1991 *EMP* gives the orbital inclination of this asteroid as 34.8° to the ecliptic. This has the effect of swinging an asteroid well away from the ecliptic as observers of the 1983 occultation of 1 Vulpeculae by this asteroid might remember. With this in mind, consider

Asteroid Appulses with Deep-Sky Objects
September-November 1991

Date (UT)	R.A.(1950) Dec.	R.A.(2000) Dec.	Sep.
Trumpler 33 and 124 Alkeste (V mag. 12.5)			
Sept 1.0	18h20.67m -19°35.7'	18h23.63m -19°34.2'	0.298°
Sept 4.0	18h22.01m -19°40.1'	18h24.97m -19°38.5'	0.057°
Sept 12.0	18h26.69m -19°50.6'	18h29.65m -19°48.7'	1.148°
M45 and 10 Hygiea (V mag. 11.1)			
Sept 11.0	3h40.32m +23°31.9'	3h43.28m +23°41.4'	1.044°
Sept 21.0	3h41.14m +23°41.8'	3h44.10m +23°51.3'	0.809°
Sept 30.0	3h40.08m +23°44.5'	3h43.04m +23°54.1'	1.031°
M42 and 148 Gallia (V mag. 12.1)			
Sept 14.0	5h29.16m -5°4.0'	5h30.41m -5°1.7'	1.282°
Sept 18.0	5h32.70m -5°37.1'	5h35.16m -5°35.2'	0.208°
Sept 21.0	5h36.07m -6°2.9'	5h38.51m -6°1.2'	1.010°
M37 and 13 Egeria (V mag. 10.8)			
Oct 14.0	5h46.18m +31°38.8	5h49.43m +31°39.8'	1.080°
Oct 20.0	5h48.62m +32°31.9	5h51.89m +32°32.7'	0.100°
Oct 27.0	5h50.03m +33°36.6	5h53.33m +33°37.3'	1.094°
M44 and 40 Harmonia (V mag. 11.1)			
Nov 10.0	8h33.94m +19°23.5'	8h36.80m +19°13.1'	1.091°
Nov 14.0	8h37.18m +19°19.2'	8h40.04m +19°8.6'	0.847°
Nov 17.0	8h39.35m +19°17.0'	8h42.21m +19°6.3'	1.018°



The path of the 12th-magnitude asteroid (148) Gallia tracks across the Orion Nebula this autumn. The tick marked S15 shows the asteroid's position at 0h GMT on September 15, 1991. The other ticks along the track show motion at intervals of three days, suggesting that (148) Gallia is just beyond the center of M42 on September 18. The chart is reproduced from Uranometria 2000.0 *chart 225 and shows stars down to 9th magnitude. Copyright 1987 Willmann-Bell, Inc.; used by special permission.*



The path of the 11th-magnitude asteroid (10) Hygiea is shown making a retrograde loop near the Pleiades, M45. The tick marked S6 shows the position of the asteroid at 0h GMT on September 6, 1991. The other ticks along the track show motion at five day intervals. The last tick, marked O6, indicates the asteroid's position at 0h GMT on October 6. This chart is reproduced from Uranometria 2000.0 *chart 132 and shows stars down to 9th magnitude. Copyright 1987 Willmann-Bell, Inc.; used by special permission.*

the appulse of the asteroid (148) Gallia with M42 this September. Look at a small-scale star chart like the *Bright Star Atlas 2000.0* and see that M42 is some 25° away from the ecliptic; the 1991 *EMP* lists (148) Gallia's orbital inclination as 25.3° so in September 1991 we're seeing this asteroid fairly close to the limit of how far it can wander away from the ecliptic. As can be seen in the map above, (148) Gallia spends about a week around a degree from the center of M42. The asteroid's calculated visual magnitude during this appulse is 12.1, so it will be a challenge to see visually, but such an appulse is so unusual, it's worth a try visually and photographically. Will it be lost in M42's nebulosity? Keep in mind, too, that the 1991 *EMP* lists (148) Gallia as having a 0.32-magnitude variability during its 20.664-day rotation period.

A second notable appulse occurs between (10) Hygiea and M45, the Pleiades, also in September. This asteroid makes a tantalizingly direct approach toward M45 only to be in the midst of a retrograde loop that pulls the asteroid away from the cluster. The sad results are plotted above, and you'll see that (10) Hygiea spends about a full month within 1.5° of the Pleiades. The asteroid's calculated visual magnitude of 11.1 during the appulse makes it an easy observing target.

The table lists some of the most easily visible appulses between September and November 1991. Five appulses are noted. Each appulse begins with the deep-sky object and the asteroid involved. The $V_{mag.}$ value is the calculated visual magnitude of the asteroid at the beginning of the appulse (this value could change by a couple tenths of a magnitude during the appulse due to asteroid rotation or actual brightness change due to illumination phase or distance). The first and last position noted marks when the asteroid is approximately 1° from the center of the deep-sky object involved. The second position noted for the appulse is the approximate date of closest approach to the center of the deep-sky object; no attempt is made to pin down the hour of closest approach. The column on the far right side of the table is the distance between the asteroid and the center of the deep-sky object.

Whether this article continues as a regular feature is a function of whether *Deep Sky* readers find it interesting and want it. In future articles objects such as fast moving asteroids (motion discernable in minutes), appulses with more/different deep-sky objects, or perhaps fainter asteroids could be included. Let us know if you find this kind of material useful or what you would like to see added. □

Paul Sventek is an active variable star observer with the AAVSO and a member of the Houston Astronomical Society.

Now wipe that silly grin off your face because I'm quite serious about this topic. Say the word "galaxies" and it's unlikely that Orion is going to come to mind. Most observers rightly think of Orion in terms of its beautiful emission, reflection, and dark nebulae, but it is also home to quite a number of faint galaxies and even some unexpected treats. So follow along and you'll discover there is much more to the Great Hunter than just M42 and the Horsehead Nebula. You won't find any of these objects plotted on Tirion's *Sky Atlas 2000.0* because they fall just below the magnitude cutoff. Instead, you'll need to use the more detailed *Uranometria 2000.0* as your guide. Most of my observations were made with a 13.1-inch Odyssey 1 at 144x and I later returned to pick up some of the fainter galaxies with my 17.5-inch f/4.4 Dobsonian operating at 220x. The best place to start hunting for galaxies is to the west of the galactic plane in the southwest portion of the constellation where Orion blends into the rich galaxy fields of Eridanus.

The barred spiral **NGC 1691** can be easily found 50' north of 8 Orionis (also known as Pi^5 Orionis), a 4th-magnitude star. At 166x, it appeared faint and very small with either a bright stellar core (magnitude 12 to 13) or else a foreground star is superposed. Backtracking to 8 Orionis and moving 50' south brings you to a much fainter elliptical galaxy, **NGC 1690**. Dominating the field is a magnitude 6.6 star 7' to the southwest and several faint stars surround the galaxy, including one at the western edge. At B magnitude 15, this object was very dim in my 13-inch but held steadily with averted vision and appeared as a very small, round, featureless disk.

Just over 2° southeast you'll find a trio of faint galaxies. The brightest is **NGC 1713**, a fairly faint and small elliptical with a gradually brighter center surrounded by a faint halo. In 1854 Lord Rosse discovered a very faint companion located 2.7' west-northwest that was missed by both John and William Herschel. As **NGC 1709** is both dim and diminutive, it's easy to see why, but a 13th-magnitude star just 45" west can help pinpoint its location. Moving 20' northeast will bring you to **NGC 1719**. This faint spiral is also very small yet clearly elongated east-west. Look for a faint star, magnitude 14 or 15, at the west end.

In the southwest corner of Orion, you'll find a group of six NGC galaxies located less than 2° east of Mu Eridani. **NGC 1670** was easy to see and hold steady with direct vision. Although small and round, it contains a brighter core and a magnitude 14 star is close southeast. Moving 28' east-northeast you'll come to **NGC 1678**, a slightly fainter oval galaxy with a small bright core. A brighter magnitude 12 star sits prominently just 40" to the west.

Travel 30' southeast and you'll arrive at a clump of four faint galaxies, **NGC 1682**, **NGC 1683**, **NGC 1684**, and **NGC 1685**. The brightest in the group, NGC 1684, appears as a fairly prominent oval oriented east-west with a large bright core. A magnitude 9 star 3' south highlights the field. Second brightest is the close neighbor NGC 1682, 3' to the west. Although fairly faint, it had a bright core and a stellar nucleus. The faintest member of the group, NGC 1683, is 5' further north. This dim, low surface brightness galaxy was found hiding among an elongated group of five magnitude 14 stars. Finally, NGC 1685 is also located in the same field 5' to the northeast. Look for a slight elongation northwest-southeast and a magnitude 14 star off the southeast edge.

While you're here near the Eridanus border, let's locate **NGC 1661** to the northwest. This faint, small spiral appears roundish and contains a brighter core. Look for a line of four stars oriented east-west situated just 2' south. As a side trip, you can cross the Eridanus border just 20' to the west and take a peek at the pair of galaxies, **NGC 1654** and **NGC 1657**.

Now head back to the NGC 1684 group and then turn your scope about 2° east-southeast. You'll come to a loosely knit trio whose brightest member is **NGC 1729**. In my 17.5-inch at 220x, it appeared elongated roughly north-south and was bracketed by an 11th-magnitude star off the east end and a 13th magnitude star off the northwest side. About 25' east you'll find a similar galaxy, NGC 1740, which is elongated northeast-southwest and contains a small bright core. At the southwest edge is positioned a star between 12th and 13th magnitude. Finally, look just 10' east and you may glimpse the very dim **NGC 1753**. This galaxy required averted vision to see well and a close, faint double star, perhaps composed of magnitude 13 and 15 components, was visible 3' southeast.

If you now return to 8 Orionis, where we started, and then move 80' southeast, you'll come to the 4.5 magnitude star 10 Orionis. Another hop 50' east brings you to **ADS 3623**, a pleasing magnitude 6.5 and 7.7 duo with a separation of 14". **NGC 1762** can then easily be found by drifting 1.6' from this pair (or moving 24' due east). The drifting method works perfectly on altazimuth scopes and floating through my field was a faint, small oval galaxy, extended north-south with a magnitude 13 or 14 star attached at the east end. Another spiral, **NGC 1819**, is located 43' west of a magnitude 5.5 star about 4° northeast of NGC 1762. This small galaxy was elongated southeast-northwest (position angle 120°) and contained a noticeably brighter core.

Of course, no trip to Orion would be complete without a deep, long gaze at the breathtaking Orion Nebula, M42. Take your time but when you're done move your scope just 2° west for a big surprise — **NGC 1924**. I'm amazed that a fairly bright galaxy this close to M42 has not been mentioned often before. NGC 1924 appeared moderately bright and large (the best of the Orion galaxies) with a slightly brighter core. It was bracketed by a magnitude 9 star 4' northwest and a magnitude 8 star 4' east. Next time you're gazing into the sword of Orion, take a look at this neglected galaxy.

The northeast portion of Orion flows into the dusty Milky Way where galaxies are generally blotted out from view but 4.5° north of Betelgeuse, you'll run across the solitary galaxy **NGC 2119**. As expected, the star fields are rich here but the galaxy was not too difficult to pick out in my 17.5-inch scope at 220x. A small oval oriented northwest-southeast with a bright core was visible and a 10th-magnitude field star was positioned 2' northeast.

For the last leg of our journey, head straight to Bellatrix (Gamma Orionis), the upper right star in the outline of the hunter. Just under 1° west-northwest you may pick up a very small, round

object catalogued as **NGC 1875**. A faint stellar nucleus was visible and a 14th-magnitude star could be seen about 1' west. I later noticed on the *POSS* that an interacting triplet of galaxies is located just southeast. Anyone want to give these a try?

We've now run across several small groups. Just over 1° west of NGC 1875 you'll run into a very different animal, a rich cluster of galaxies. First catalogued in 1957 by George Abell as number 539 in his list of 2712 galaxy clusters, its brightest members shine at only 15th magnitude (photographic). But this cluster is worth the effort because eight members were located in my 17.5-incher in one small field. None of these galaxies are listed in either the *NGC* or *IC* and so you'll need to refer to Zwicky's *Catalogue of Galaxies and Clusters of Galaxies* (*CGCG*) for identifications. The brightest member, **Z421-18**, is actually a triple system and is part of VV 161, a chain of five or six galaxies. With close scrutiny, I could resolve two objects, oriented north-south. In addition, several other nearby members of this chain were visible with averted vision. Search this field carefully, as these objects are quite small and dim and could be passed over for extremely faint stars even at moderate power.

The next clear night you're observing, why not take a break from the usual fare of open clusters and nebulae along the winter Milky Way and head out into Orion for some galaxy hunting? I guarantee it will spice up your evening and if the transparency is good you should find success with most of these galaxies in a 10-inch or 12-inch scope.

Nearly all the information in the table is from the *Third Reference Catalogue of Bright Galaxies* (*RC3*) by Gérard de Vaucouleurs, Antoinette de Vaucouleurs, Harold G. Corwin, Jr., Ronald J. Buta, Georges Paturel, and Pascal Fouqué (Springer-Verlag, New York, 1991). A few approximate sizes and magnitudes are from the *UGC*, *CGCG*, and *MCG*. The magnitudes are total B magnitudes; as you can see for the three objects with V magnitudes given in the last column, the visual magnitudes will typically be a magnitude brighter. Thee are still moderately faint, but all the objects have high surface brightnesses, making them relatively easy to pick up at high power. □

Galaxies in Orion

Designation	R.A.(2000.0)Dec.	Type	Size	Mag.	Sfc.	P.A.	Chart
NGC 1661	4h47.1m -2°03'	SA(s)bc:II-III	1.4' by 0.9'	14.0	14.1	35°	224
NGC 1670	4h49.7m -2°46'	$SA0^0$	2.1' by 1.0'	13.7	14.3	112°	224
NGC 1678	4h51.6m -2°37'	$SA0^0$? pec	1.1' by 0.8'	14.2	13.8	110°	224
NGC 1683	4h52.3m -3°01'	—	—	—	—	—	224
NGC 1682	4h52.3m -3°06'	—	0.3'	14p	—	—	224
NGC 1684	4h52.5m -3°06'	E+: pec	2.5' by 1.7'	13p	—	—	224
NGC 1685	4h52.6m -2°57'	SB(r)0/a	1.3' by 0.9'	14.5p	—	—	224
NGC 1690	4h54.3m +1°38'	E:	1.0' by 0.3'	14.8	13.5	116°	224
NGC 1691	4h54.6m +3°16'	(R)SB(s)0/a:	1.7' by 1.5'	13.0	13.9	85°	224
NGC 1709	4h58.7m -0°29'	$SB0^0$:	0.9' by 0.7'	15.2	14.6	10°	224
NGC 1713	4h58.9m -0°29'	E+:	1.4' by 1.2'	13.7	14.3		224 (V=12.6)
NGC 1719	4h59.6m -0°16'	Sa: sp	1.1' by 0.3'	14.5	13.2	102°	224
NGC 1729	5h00.3m -3°21'	SA(s)c I-II	1.6' by 1.3'	13p	—	150°	224
NGC 1740	5h01.9m -3°18'	S0-:	1.5' by 1.2'	15p	—	125°	224
NGC 1753	5h02.5m -3°21'	(R')SBa? pec	1.4' by 0.6'	15.5p	—	15°	224
NGC 1762	5h03.6m +1°34'	SA(rs)c: II	1.7' by 1.1'	13.3	13.9	175°	224 (V=12.6)
NGC 1819	5h11.8m +5°12'	SB0	1.7' by 1.2'	13.4	14.0	120°	225
NGC 1843	5h14.1m -10°38'	SAB(s)cd: II-III	1.6' by 1.2'	13.3	13.8	50°	270
Z421-15	5h16.3m +6°26'	—	—	15.5z	—	—	180
Z421-16	5h16.5m +6°23'	—	—	15.6z	—	—	180
Z421-17	5h16.6m +6°30'	—	—	15.6z	—	—	180
Anon	5h16.6m +6°29'	—	—	16:p	—	—	180
Z421-18a	5h16.7m +6°26'	—	—	15.1z	—	—	180
Z421-18b	5h16.7m +6°26'	—	—	15.1z	—	—	180
Anon	5h16.8m +6°29'	—	—	16:p	—	—	180
Z421-19	5h17.0m +6°33'	—	—	15.6z	—	—	180
NGC 1875	5h21.8m +6°41'	Sa0-:	1.6' by 0.4'	14.6	14.1	—	180
NGC 1924	5h27.9m -5°19'	SB(r)bc II-III	1.6' by 1.2'	13.3	13.8	50°	225 (V=12.5)
NGC 2110	5h52.2m -7°27'	Sa0-	1.7' by 1.3'	—	—	20°	271
NGC 2119	5h57.4m +11°57'	E	(1.2' by 1.0')	15:p	—	—	181

Did you know about the bright galaxy NGC 1924, an object located just 2° west of the Orion Nebula? Jack Marling's photo shows the galaxy's position (arrow). Exposure data: 200mm f/2.8 lens, hypersensitized Tech Pan film, hydrogen-alpha filter, 40-minute exposure.

Steve Gottlieb is an enthusiastic galaxy observer living in Albany, California. He is a frequent contributor to Deep Sky.

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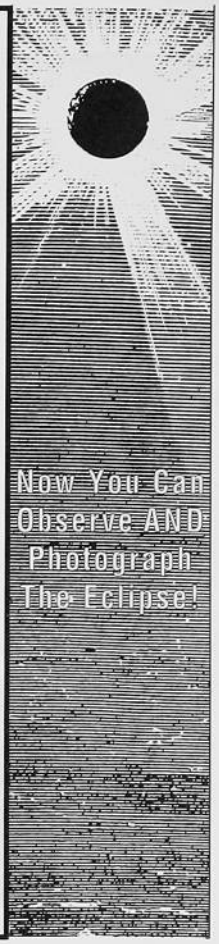

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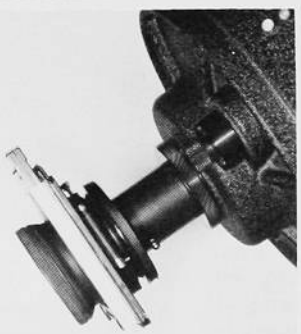

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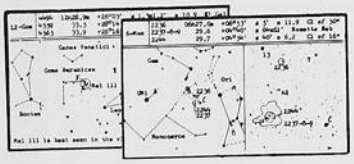

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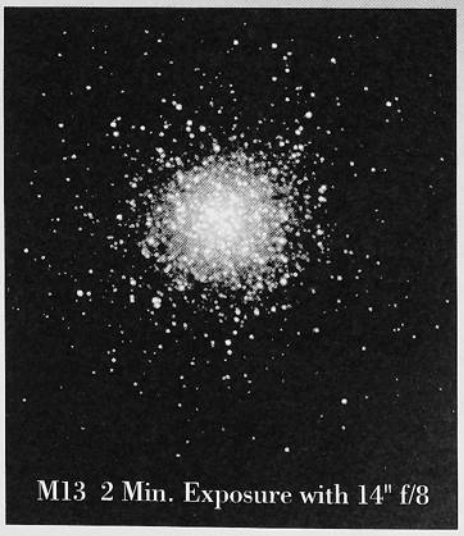
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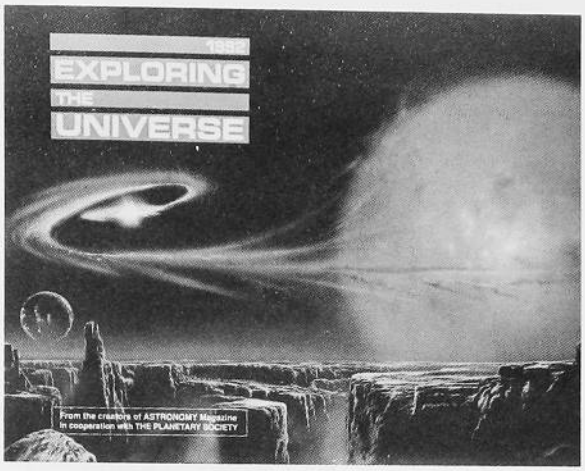

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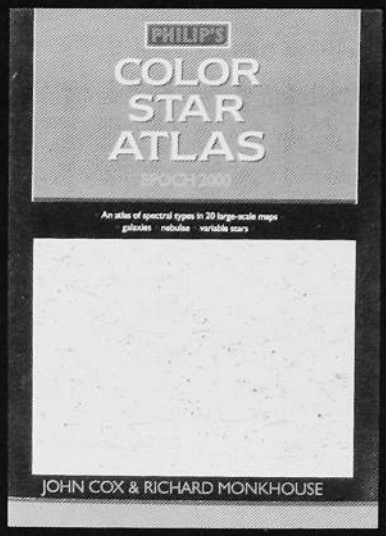

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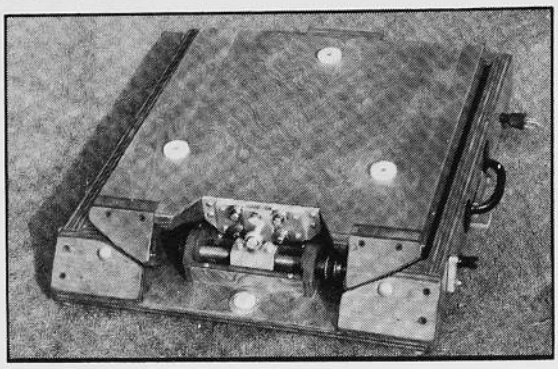

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Visual Astronomy of the Deep Sky, by Roger N. Clark, (Cambridge University Press, 1990), ISBN 0-521-36155-4, hardcover, 354 pages, $39.50.

It happens all the time! A first time telescope owner is disappointed by the first look at a deep-sky object. Why? Because it looks nothing like the fine pictures seen in astronomy books. For this reason, I am interested in books that use drawings to illustrate what an observer can expect to see. I am even more impressed when those drawings are placed beside a photograph for the reader to compare. Early advertisements indicated that *Visual Astronomy of the Deep Sky* by Roger Clark was just such a book. And when it was announced in 1989, I could hardly wait to get a copy. But I would have to wait. Problems with the layout forced lengthy delays. It took almost 18 months from the time I first heard about the book to get a copy. I learned later that this was only the tip of the iceberg. The problems were so severe that it took Cambridge over four years to bring the book to press!

(As if the delay in publication was not enough, I received a letter from Brian Skiff alerting me to some "problems" with the book before I had a chance to start reading it. More on this later.)

But the lengthy delays and potential problems could not dampen my enthusiasm. I had looked forward to this book for a long time and when I finally began reading it, I was not disappointed.

True to its title, *Visual Astronomy of the Deep Sky* focuses on the visual aspects of deep-sky observing with excellent drawings that accurately reflect what can be seen through the telescope.

What makes this book unique is Clark's approach to the subject. Unlike other books which refer to deep-sky objects by magnitude alone, *Visual Astronomy of the Deep Sky* focuses on surface brightness. This provides a much better idea about the visibility of deep-sky objects that magnitude estimates alone. Clark also places other aspects of deep-sky observing in the proper context. For example, the author strongly points out that magnification — not f/ratio — has a strong influence on views seen through the telescope.

The great Sculptor galaxy NGC 300 photographed by Martin C. Germano (8-inch f/5 reflector, hypersensitized Tech Pan film, 60-minute exposure with coma corrector.

Furthermore, low power is not always best for viewing deep-sky objects.

Clark also introduces new ideas that are sure to change the way amateur astronomers look at the sky. The most notable is "optimum magnification visual angle," as Clark calls it, which is in reality nothing more than the optimum observing magnification for a given object.

The book begins with several short chapters, each devoted to a different aspect of visual observing. The first chapter covers the workings of the human eye with specifics on how to maximize visual observation. Topics like averted vision are discussed in detail rarely found in other books. For instance, Clark indicates how to achieve the best results with averted vision by indicating how far to look away from the object observed and in what direction.

For the most part, this depth is reached in other chapters which include topics such as eyepieces, telescopes and mounts, filters, star hopping techniques, and using setting circles.

Beginning and intermediate observers might find this book's treatment hard to follow. But chapter summaries give a brief, non-technical synopsis of each chapter. Clark recommends that neophytes skip the main text and move right to the chapter summaries — an indication straight from the author that this book is for advanced amateurs.

The heart of this book is the list of 90 deep-sky objects which the author has sketched. Listed by order of increasing Right Ascension, the drawings are accompanied by detailed descriptions which are broken down into two categories: technical and visual. The technical description gives information on when the object was discovered, by whom, the object's distance, and other trivia of interest that has no direct bearing on observation. The visual section gives detailed descriptions of what the object looks like and how to get the most out of an observation. This is where Clark gives specifics on angular size, magnitude, surface brightness, and contrast.

Following this are Clark's drawings which are placed right next to photographs of the same object. Both are reproduced at the same scale for easy comparison.

The author includes information on the scale of the drawing, what instrument was used for the observation, eyepiece and power. He also provides information on the faintest star seen at the time the drawing was made, the date and time when the drawing was

made and observing location. In addition to the above information, Clark also indicates how far to hold the picture from the eye to produce various magnifications. Such information really helps the reader get a clear picture of how the object looks through a telescope at different powers.

The book concludes with several appendices that contain a wealth of information above and beyond the normal text. One appendix illustrates numerous star clusters used to determine the faintest star seen each observing session. Each cluster is shown twice, once with magnitudes for each member and one without. Another provides a list of 611 objects well within the reach of amateur instruments. This mini catalog includes much of the information listed for those objects which Clark sketched.

I have two complaints with *Visual Astronomy of the Deep Sky* — one minor and the other a little more severe. First, the discussion of eyepiece coatings is much too brief, both in relation to the topic itself and in comparison to the treatment Clark gives other topics. Terms like "multicoating" are introduced but not adequately defined while terms like "fully multicoated" are never introduced.

The second problem I had with the book was in comparing the photos to the drawings. The photos are normal black and white prints while the drawings are the equivalent of negative prints (i.e., black stars on a white background). This reversal makes direct comparison a little tricky. I tried comparing the Trifid Nebula drawing with the photograph to see how much detail Clark observed. It was not easy since the primary features in the drawing are reversed in the photograph.

Now for the problems noted by Brian Skiff. As I mentioned earlier, Clark's approach is different in that it focuses on surface brightness, not magnitude. This, in turn, is used to determine contrast which produces a certain contrast when seen against the background sky. The problem arises from the question, how bright is the night sky? In chapter six, Clark deals exclusively with visual detection using M51 as a case study to compare the object's brightness with that of the background sky. Clark maintains that the brightness of the background sky from a good site is magnitude 24, and sometimes fainter.

According to Skiff, the background sky is never fainter than magnitude 22. The brightness of the background sky in conjunction with an object's surface brightness produces a certain contrast, thus determining the object's visibility. While this two magnitude discrepancy seems small, it affects the contrast (visibility) which is the foundation of Clark's book.

Another point Skiff made in his letter is that several of the magnitude estimates of objects are off — some by as many as three magnitudes! While this may seem like a huge discrepancy, it actually raises another question — how should visual magnitude estimates be made? Clark's stance is that his estimates of galaxies, for example, are for portions visible through the telescope. Other estimates, he contends, include outlying regions visible only in long exposure photographs.

While initially these problems seemed quite substantial, they really have raised issues about aspects of astronomy that we have taken for granted for years. At this point, the debate continues and I am not sure who is correct. One thing is certain: both Skiff and Clark will be writing articles on the subject.

But the bottom line is these uncertainties do not, in my opinion, detract substantially from the book's usefulness. In fact, amateurs who heed Clark's advice will have reason to go back and re-examine every object they have already observed and add some new objects to observing lists that had been left off previously simply because they were thought to be beyond the reach of amateur scopes.

The Practical Astronomer, by Brian Jones, (Simon and Schuster, 1990), ISBN 0-671-69304-2, hardcover, 160 pages, $24.95.

It began like any other phone conversation with Steve Edberg.

"Hello."

"Hello Steve, it's Mark. How are you doing?"

"Good, and you?"

"Fine, thanks. I just got a copy of your new book."

"What book?"

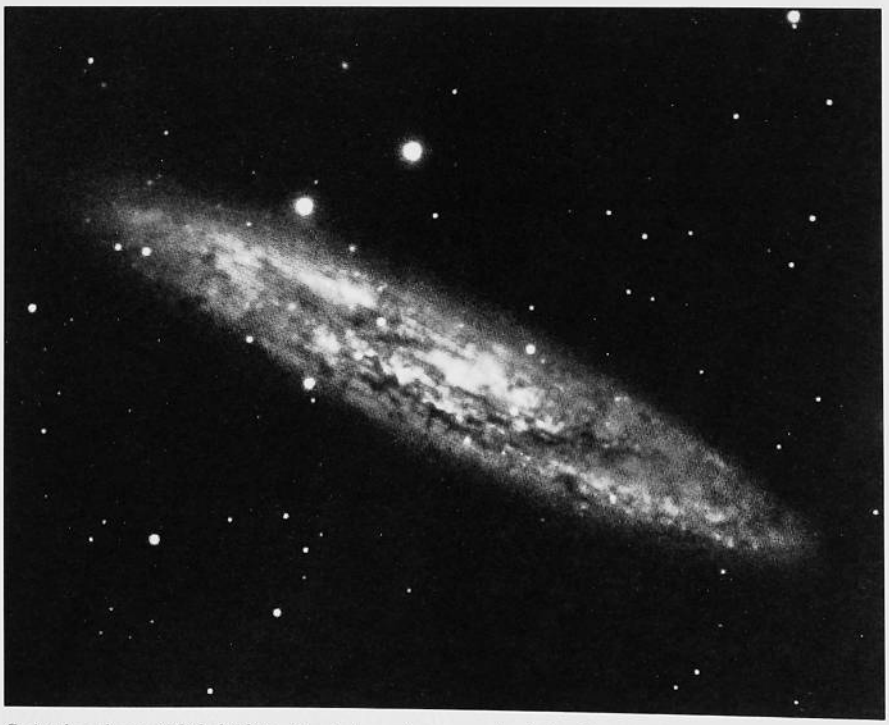
"*The Practical Astronomer* — the one you edited for Brian Jones."

The short but questioning pause that followed indicated that Steve had no idea what I was taking about.

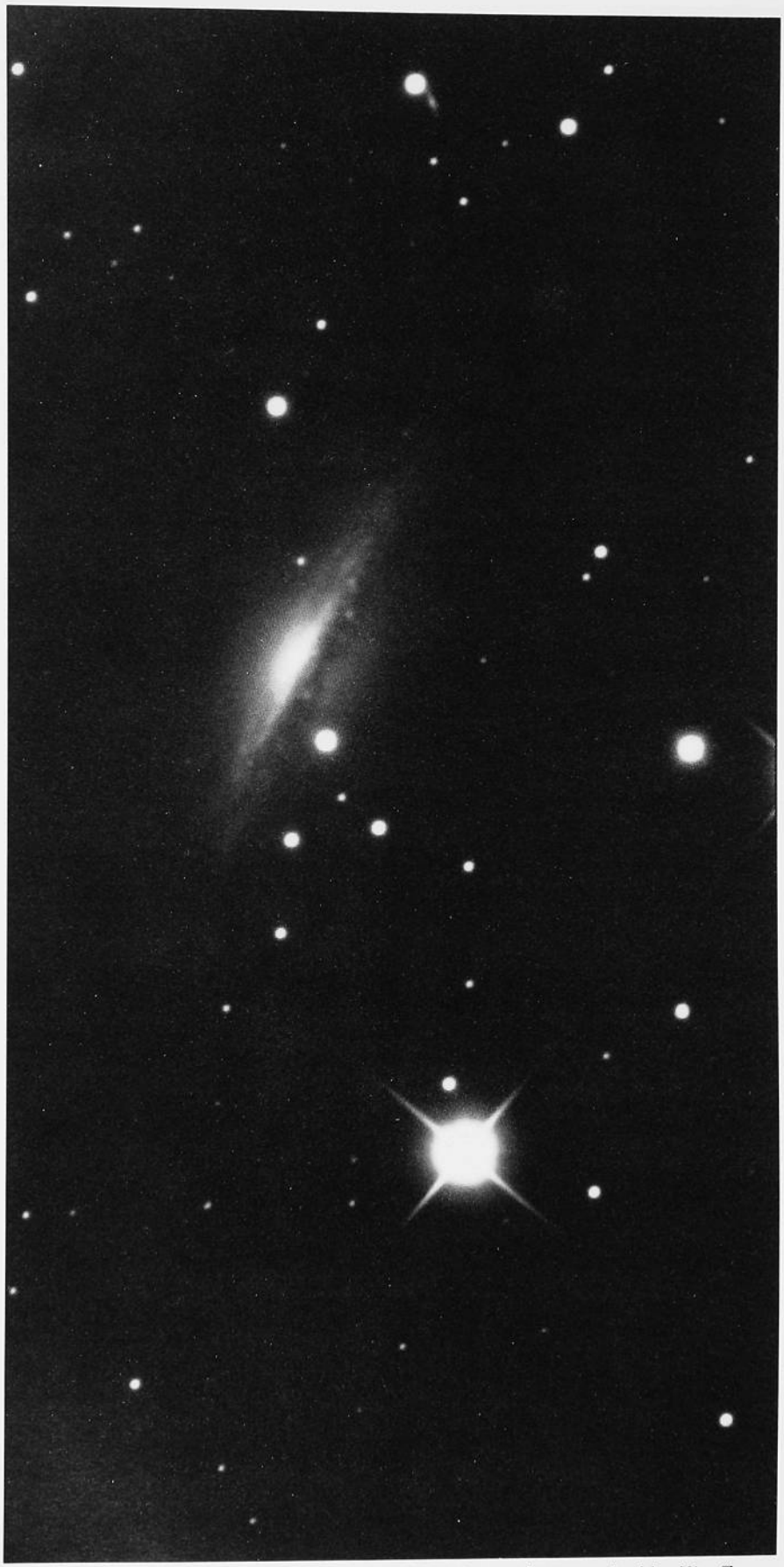
As I learned in the next few minutes, Simon and Schuster, the publisher of *The Practical Astronomer*, sent Edberg a copy of Jones' manuscript and asked for a few comments. Edberg read the manuscript, made the comments he felt were appropriate and returned it. And that was the end of it — or so he thought. As a way of saying thank you, the publisher placed Edberg's name on the cover, billing him as editor.

Unfortunately, this is not a title Edberg deserves since they didn't take many of his suggestions. It's a pity they didn't since it would have undoubtedly made the book better.

The Practical Astronomer has a boilerplate look, resembling other books on the same subject, many of which come out of England. I get the feeling these types of books are hastily written and published with little attention given to detail or specific accuracy.



Spiral galaxy NGC 253 in Sculptor photographed by Jim Riffle (12-inch f/5 Astro-Mak, hypersensitized Tech Pan sheet film, 60-minute exposure).



The wonderful edge-on galaxy NGC 1055 in Cetus photographed by Kim Zussman (14.5-inch f/8 Cassegrain, hypersensitized Tech Pan film, 90-minute exposure).

The first paragraph put a sour taste in my mouth simply because it contained three typos. Ensuing pages showed more of the same poor editing as grammatical errors abounded. The author could not decide whether to spell Sun with a capital or a lower case "s." When in doubt at least be consistent in usage!

The first half of the book is an encyclopedia-type description of the universe, starting with the solar system and working out to the most distant galaxies. The text here deals with the physical nature of the objects described, not observation.

The second half turns toward observing, which begins by describing the motions of Earth and then applying those motions to the heavens. Introductory observational information includes very brief descriptions of optics — binoculars, telescopes and eyepieces — as well as mounts.

After this introductory observing information, the remainder of the second half of the book pretty much follows the first half in terms of topics covered.

However, now the emphasis is observational, not technical. Virtually each two-page spread covers a single topic, though some extend four or maybe six pages. The nice thing about this type of layout is that each spread is self-contained — no need to look further for additional information and it makes for easy reference.

The illustrations in this section are quite good. But that's about all that's good. Every subject is covered so briefly that the information is virtually useless. Major topics like building a telescope, building an observatory, and astrophotography are given four pages each. While books have been written on each of these subjects, some — like building an observatory — are completely outside the realm of the neophyte.

The book concludes with monthly sky charts (January to December) covering the entire sky — pole-to-pole. The charts, which show stars to magnitude 6.5, are poorly designed containing far too many objects for the intended audience. They are cluttered and as a result, and difficult to read.

Although the book is well-illustrated, it is mechanical in appearance and coverage. Furthermore, the information is so incomplete that it raises more questions than it answers. Would-be authors can learn a great lesson from *The Practical Astronomer* — don't try covering every aspect of astronomy in 160 pages!

The Monthly Sky Guide, by Ian Ridpath and Wil Tirion, (Cambridge Uni-

versity Press, 1990), ISBN 0-521-38665-9, hardcover, 64 pages, $9.95.

The Monthly Sky Guide is a great introduction to naked-eye observing, utilizing simple little star charts to teach new observers the night sky.

Originally published in 1987, the book has just been published in a second edition by Cambridge University Press. The reason for the new edition is to update the planetary information, which comprises only a small but important part of the guide.

Before getting into the sky maps, the authors introduce the reader to some of the basics of observing. These include information on the physical nature of stars, how to observe them, how they are named, their distances and brightness (this latter section talks about observed brightness while later in the book the authors talk about absolute magnitudes for specific stars).

The authors then move to discussing the appearance of other objects in the sky — like meteors, comets, nebulae, galaxies, double stars, and variable stars. Also covered is information on the scale of the sky, using the human hand held at arms length as a guide. Conveniently, drawings of the properly scaled hand are superimposed on some star maps to help give accurate gauge of angular distance — a problem common to first time stargazers. The text also covers general signposts to the night sky, singling out bright star patterns for each season.

After this introductory data, the authors jump into the star maps. The maps are of two kinds; wide-field showing the entire sky, and narrower field highlighting only a few constellations. The wide-field maps are laid out by month beginning with January and working through to December. Each monthly map shows the entire sky for observers between 30° and 60° north latitude and plots stars to fifth magnitude. (Extreme southern hemisphere constellations are not included.) In addition to bright stars, wide field maps also show some of the brightest deep sky objects — usually those visible to the naked eye.

The text accompanying the maps begins with a description of where the planets are located. Broken down by year, planetary information is included through 1994. Following this is a discussion of featured constellations, usually only two. These featured constellation are accompanied by larger scale sky maps. The authors included the properly scaled human hands on these maps.

Since the thrust of the book is for naked-eye observers, bright objects are the focus with the majority being variable stars. The information is sprinkled with mythological data to round out the description. The authors also included information on some of the brighter deep-sky objects, some visible to the naked eye and others visible in binoculars or small telescopes. Some discussions include naked-eye features of the Milky Way, like the great rift, or external galaxies, like the Andromeda Galaxy. The authors also included technical information on distance and actual brightness.

The text is easy to read and quite informative. Beginners interested in a general introduction to the night sky will find *The Monthly Sky Guide* an ideal companion.

In The Stream of the Stars; The Soviet/American Space Art Book, edited by William K. Hartmann, Andrei Sokolov, Ron Miller, and Vitaly Myagkov, (Workman Publishing, 1990), ISBN 0-89480-875-3, hardcover, 184 pages, $29.95.

I have never cared much for space art. I guess I prefer the real to the surreal. But *In the Stream of the Stars* turned me around, stirring my intellecutual curiosity and emotions. This collaboration between Soviet and American space artists contains hundreds of paintings done by today's most prominent talent. The paintings range from depictions of familiar scenes captured by photojournalists and NASA spacecraft to surrealistic views limited only by the artists' imaginations.

In the Stream of the Stars focuses primarily on the history of space art. One enjoyable pair of images shows a spacecraft landing on the planet Mars. The perspective from the Martian surface shows a small flower blossoming not too far from where the craft will touch down. The caption implores the reader to think of our readiness to explore and colonize other worlds when we have not yet learned how to care for our own.

Another painting shows the space shuttle *Challenger* from the underside silhouetted against a bright background and surrounded by seven bright stars. This is by far one of the most rousing tributes to seven astronauts who lost their lives in the *Challanger* accident.

While the paintings take center stage, several accompanying articles offer an added bonus. Two such articles are written by firsthand space travelers. Alexi Leonov of the Soviet Union and Alan Bean of the United States. Both are artists and have painted scenes from space.

Words alone cannot do this book justice. The paintings are something that must be experienced.

Astrophoto IX Proceedings, edited by John Sanford, (OCA Publications, 1991), softcover, 44 pages, $11.

Every two years the Ventura County Astronomical Society and the Orange County Astronomers in California jointly sponsor a conference on astrophotography. In addition to producing great talks on the subject, the conference also yields a proceeding, a printed record of those talks. In some cases, papers are included that were not presented at the conference. While this work is by no means a major publication, it has a professional look and contains articles not published elsewhere.

This proceedings volume of the Astrophoto IX conference contains a wide range of articles including beginning astrophotography, advanced galaxy photography with Kodak 2415, unsharp masking techniques, medium format photography with Konica 3200, and more. When the conference started back in the 1970s, all the talks centered on photo-chemical imaging. Now, with the introduction of CCDs to the amateur market, electronic imaging is creeping in. While this is not surprising, the conference planners may wind up combining this conference with the Electronics Oriented Astronomy conference which both clubs sponsor on alternate years with the Astrophotography conference.

What I find interesting about the conference and the proceedings is that some of the information is ground breaking. For example, Michael Stecker presented a paper on long exposure astrophotography with the SBIG ST-4 star tracker. His quantitative analysis is sure to save others hours of frustration.

The only drawback to this publication is that some of the talks presented are not included in the proceedings. Most notably absent from the proceedings was a paper on image processing by Richard Berry. The presentation was excellent and it would have been nice to have a written copy for reference.

If you can't attend the conference, the proceedings provide a nice summary and make a great reference. Copies can be purchased from OCA Publications at 2195 Raleigh Avenue, Costa Mesa, CA 92627 for $11.00 postpaid. □

Mark J. Coco is an employee at Celestron International, one of the world's largest manufacturers of telescopes. He is also an expert deep-sky observer and astrophotographer.

Deep Sky Reports

Autumn's Challenging Deep-Sky Objects

by Phil Harrington

I don't know about your local climate, but in my part of the world, autumn is traditionally the clearest season. Sure, it is tough to beat a cold winter's night after an arctic high has swept the air clean. Those nights are always spectacular! But in terms of sheer numbers, autumn has more clear nights than any other season. This, combined with moderate temperatures, makes now the best time to go outside and see just what is going on over your head. Believe me, there is a lot! Here is a selection of some of the most challenging objects visible in our sky tonight. Are you up to the challenge?

Binoculars: Stock 2

Stats: R.A. 2h15.0m, Dec. +59°16′ (2000.0) Constellation: Cassiopeia Magnitude: 4.4 Size: 60′ open cluster

This object is sure to become a seasonal favorite of yours just as it has become one of mine. Stock 2 is a fine open cluster lying only 2° north of the famous Double Cluster in Perseus. Spanning a full degree across, Stock 2 consists of fifty stars shining at 8th magnitude or fainter. Seven-power binoculars unveil many cluster members sprayed onto the glow of fainter suns.

Many observers enjoy playing connect-the-dots among the stars of Stock 2. For instance, to Alister Ling and Jonathan Doupe of Edmonton, Alberta, Canada, the group resembles a bug with antennae or perhaps even a pineapple when a V-shaped stellar asterism seen to the east is added into the picture (see *Deep Sky* #23, page 34)

You might see something else. In *Touring the Universe Through Binoculars* (John Wiley and Sons, 1990), I call it the "Muscle Man Cluster" after a friend's suggestion. A few years ago, John Davis, an ardent deep-sky observer from Amherst, Massachusetts, drew for me within Stock 2 a portrait of a headless stick figure flexing his (or her) muscles. The V-shaped asterism represents the person's legs, the body is marked by a thin line of stars extending to the west, while the arms are created by two curves of stars centrally located in the cluster. The person's hands are marked by two 7th-magnitude suns at the ends of either arc.

Muscle man or pineapple? You make the choice. One thing is for certain, though: intrigue lies among the stars of Stock 2. On the next clear autumn night, before you immediately go to the Double Cluster, be sure to pay a visit to Stock 2.

NGC 6946 photographed by George Greany (14-inch SCT at f/7, hypersensitized Tech Pan film, 60-minute exposure).

4- to 6-inch telescopes: NGC 6946

Stats: R.A. 20h34.8m, Dec. +60°09′ Con.: Cepheus Mag.: 8.9 Size: 11′ by 10′ spiral galaxy

Two decades ago, one of the first books I ever read on astronomy had a photograph of a magnificent spiral galaxy only identified as "in Cepheus." Some time later, I came across another book that contained the same photo, but referred to it as NGC 6946. I just had to see this galaxy for myself!

Turning to my old (now deceased) star atlas, I found NGC 6946 just south of a triangle of 6th-magnitude stars about 3° southwest of Eta Cephei. But when I aimed my department-store 2.4-inch refractor toward its location, the galaxy was nowhere to be seen. Try as I might, I just couldn't find it. I was devastated!

When I finally returned to that spot again several years later), I came armed with an 8-inch Newtonian. This time, even through mediocre suburban skies, the galaxy had no choice but to reveal itself. At long last, victory was mine.

Subsequently, I have enjoyed viewing NGC 6946 through a number of instruments ranging from 11 x 80 binoculars to an 18-inch reflector. Though some spiral structure could be seen in the 18-inch, the others showed only a dim nebulous glow. Through 4- to 6-inch telescopes, the galaxy teeters on the edge of visibility even on good nights. Its gray, oval spiral-arm disk glows ever so faintly amidst a well stocked field of stars.

Like M33 and so many other broadside spiral galaxies, NGC 6946's large apparent diameter creates a deceptively high integrated magnitude but an exceedingly low surface brightness. So, even though it is listed as 9th-magnitude, its surface brightness shines at about 13th magnitude. Because of the galaxy's subtleness, you might be surprised to learn that it lies "only" 16 million light years away — just beyond the boundaries of the Milky Way's Local Group.

If, after searching for NGC 6946, you are still having trouble pinning it down, why not take a break and look at nearby NGC 6939. This object is one of the richest open clusters in the northern autumn sky, with 80 stars crushed into 8′. None of the cluster stars shine at greater than 12th magnitude, causing the group to appear as a bright stellar

mist through 4- to 6-inch scopes.

8- to 10-inch telescopes: NGC 7492

Stats: R.A. 23h08.4m, Dec. -15°37' Con.: Aquarius Mag.: 11.5 Size: 6' globular cluster

Winchester, Virginia amateur Bryan Henry suggested this challenging object for the 8-to-10-inch set. Bryan, a globular cluster aficionado, writes that through his 10-inch f/4.5 Newtonian, NGC 7492 is an excellent test for night-sky clarity. He describes it as "pretty large, round, extremely faint, with neither a central brightening nor resolution suspected" at 127x. Moving up to a 17.5-inch reflector, he noted a "mottling, as if on the verge of resolution."

To find NGC 7492, start at Delta Aquarii, located about 15° southeast of the constellation's famous "Water Jar" asterism. Once Delta is in view, you can let the Earth do the rest as the globular lies about 3.5° due east. Turn off your clock drive, and in about 13 minutes, NGC 7492 should be in the field of view, just a little north of center.

12- to 14-inch telescopes: NGC 1049

Stats: R.A. 2h37.7m, Dec. -34°28' Con.: Fornax Mag.: 12.6 Size: 0.8' globular cluster

E356-SC01

Stats: R.A. 2h36.7m, Dec. -35°02' Con.: Fornax Mag.: 13.5 Size: 1.2' globular cluster

E356-SC05

Stats: R.A. 2h38.1m, Dec. -34°45' Con.: Fornax Mag,: 13.6 Size: 0.6' globular cluster

E356-SC08

Stats: R.A. 2h40.3m, Dec. -34°19' Con.: Fornax Mag.: 13.4 Size: 0.8' globular cluster

Fornax Dwarf Galaxy

Stats: R.A. 2h 37.9m, Dec. -34°40' Con.: Fornax Magnitude: 8.4 Size: 20' by 14' galaxy

One of the most unusual galaxies in the sky rides low in the south on autumn nights. The Fornax System, as it has come to be known, is a member of our Local Group of galaxies. Classified as a dwarf elliptical or spheroidal galaxy, the Fornax System is believed to lie about 130 kiloparsecs from the Milky Way. Yet even though is so close by, it appears as little more than an elliptical haze peppered by some 19th-magnitude stars. (Now that's what I call a challenging object!)

While the galaxy itself may be beyond the range of amateur telescopes, a few globular clusters associated with it

The Fornax Dwarf galaxy photographed at the U.S. Naval Observatory. The globular cluster NGC 1049 lies near the top of the image. Official U.S. Navy photograph.

are within our grasp. Of the faint globulars known to surround the Fornax System, NGC 1049 is the brightest. Can you pick it out?

Part of the problem in finding NGC 1049 is locating its position in the sky. Fornax is not an easy constellation to see. Your best bet is to start at the pentagon representing the tail of Cetus the Whale. Drop about 35° southward along the Cetus-Eridanus border and into Fornax. Keep an eye out for 3rd-magnitude Beta Fornacis. Just south of Beta lies a small isosceles triangle consisting of Eta^1, Eta^2, and Eta^3 Fornacis. Follow the "point" (Eta^1) to the northwest toward Lambda^2 Fornacis. From Lambda, slide about 0.75° northeast to find the globular cluster.

Though some observers claim to have seen NGC 1049 in telescopes as small as 6-inchers, I feel that it remains a difficult test in apertures twice the size when viewed through suburban skies. Through my 13.1-inch f/4.5 Newtonian, I recorded it as round, measuring about 1' across, and shining at about 13th magnitude. At 125x, a vague stellar central core was noted. This nucleus grew in prominence slightly as I increased magnification to 214x. Regardless of aperture, however, there is little hope of resolving any of the cluster's faint stars.

Three of the galaxy's other globular clusters also lie within range of large backyard instruments. The brightest of these, designated E356-SC08, lies 40' northeast of NGC 1049. In their book *Observing Handbook and Catalogue of Deep-Sky Objects* (Cambridge University Press, 1990), authors Christian Luginbuhl and Brian Skiff report they have glimpsed both as stellar points in a 6-inch telescope. Ahh, to live in Arizona! Through a 12-inch instrument, they feel that E356-SC08 may be a little brighter than NGC 1049. Meanwhile, here on the East Coast, E356-SC08 struck me as a little smaller and a little fainter that NGC 1049. What is your interpretation?

E356-SC05 is smaller and fainter than either of the above globulars. Look for a tiny diffuse disk about 18' southeast of NGC 1049. Most difficult of all is E356-SC01. Though it appears the largest of the four, an exceedingly low surface brightness makes it difficult to confirm. E356-SC01 is situated 37' southwest of NGC 1049. Luginbuhl and Skiff tell us it is visible in their 12-inch Cassegrainian reflector at 250x, but I have been unable to duplicate this feat in my 13.1-inch Newtonian here on Long Island. Maybe I should consider relocating! □

Phil Harrington lives in Smithtown, New York. His first book, "Touring the Universe Through Binoculars," was published last year by John Wiley & Sons.

Small Scope Showcase

The Sparkling Darkness

by Alister Ling

David Levy once pointed out how many seasonal astronomy articles start off by mentioning the typical weather or temperatures for that time of year. It's a hard thing to avoid since our observing is very much tied to the weather or season. Mention "Orion" and immediately "winter" comes to mind; "Pegasus" leads to "fall." You can imagine seeing Pegasus in spring and have this shock come over you — Oh no, summer's already over!

One autumnal sky characteristic that stands out in my mind is transparency. A related, though not identical characteristic, is sky darkness. It is possible to have a very dark sky that is not transparent due to haze. Also, one can have a very dry and transparent sky, with light pollution reducing the darkness. However, the two usually get lumped together. After all, they are not independent — a transparent city sky is a lot darker than a hazy one.

After a summer of warm hazy nights, the superior skies of fall are a welcome relief. From downtown Montreal I requently used deep-sky objects to gauge the transparency of the sky. My 4.5-inch reflector could show me M57 overhead, but once the planetary dropped lower than 50° above the horizon, it didn't stand a chance against the sky glow, unless the air was very dry.

Skyglow is a pretty insidious enemy — it really warps one's perspective. It can overwhelm nebulosity while reducing the limiting magnitude only a bit. Over fifteen years ago, when I was young and not so experienced, I made some strange statements that I can now attribute to this phenomenon.

I noted that from the city, the **Andromeda Galaxy** (M31, NGC 224) was only a wee bit "brighter" in a C-14 compared to a little 3-inch reflector! Little did I realize then that this observation, in itself, highlights a feature of our neighboring galaxy. There is a bright oval disk surrounded by a significantly fainter outer region. It only took one trip away from the city to hammer home how nebulous objects appear incredibly better in country skies — M31 simply flowed out of the field.

On an interesting aside, there is a poster of the Andromeda Galaxy that distinctly, to me anyway, shows the outer faint areas of the disk to be warped. The effect is most pronounced in color. The northeast end seems to be "cupped" toward NGC 205 and the southwest end seems to be concave toward M32. Perhaps this is an illusion created by the distribution of dust in the galaxy.

M29 is one of the smallest (and prettiest) Messier objects. Photo by Lee C. Coombs (10-inch f/5 reflector, 103a-O film, 5-minute exposure).

From dark skies, **M32** (NGC 221) was clearly nebulous at low power in the 4.5-inch scope, while **NGC 205** completed the pretty sight. Back in the city, it took high power (150x) to recognize M32 as nonstellar. NGC 205 was nowhere to be seen, even in the C-14. Despite the better conditions at the farm, the hunger to observe pushed me to watch the skies from the city. I only recorded one night to be so transparent that I could see NGC 205 with my 10-inch. Not surprisingly, both M31 and M32 were bigger and more obvious than normal.

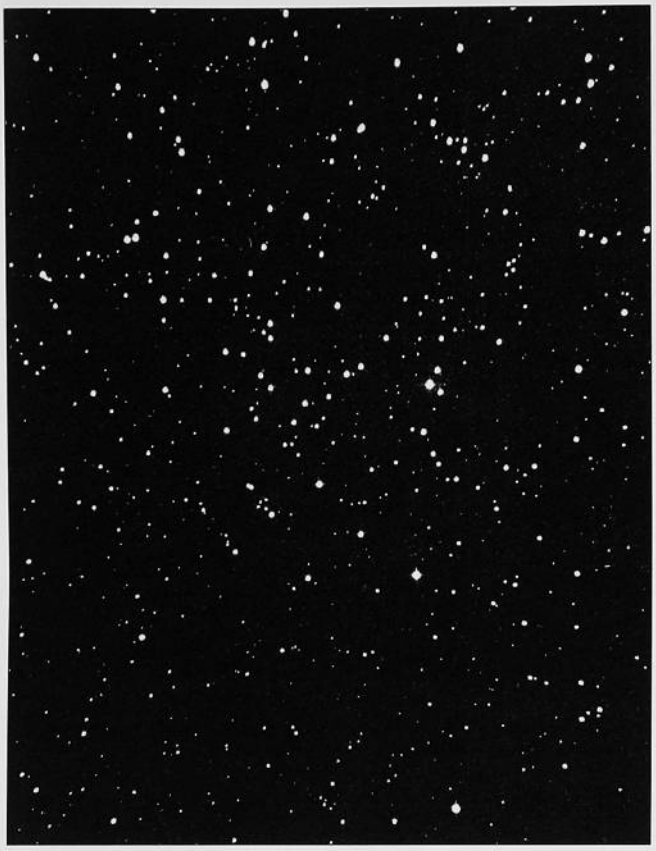
Experience being a good teacher, it didn't take me long to figure out that the most deep-sky objects suitable for viewing from the city were open clusters. **M39** in the northern reaches of Cygnus is one of my favorites. It shines in all its glory in a small scope at low power. The group's triangle form gives it a most unusual appearance. The cluster sparkles with randomly strewn, bright blue-white stars that have no comparison in the vicinity.

I was astonished to see my statement of fifteen years ago say that there was not much point observing clusters from the country. In retrospect this is understandable. I found that most of the bright Messier open clusters showed little improvement in a darker sky. In fact, some like **M29** became quite tough to find amidst the Milky Way stars. From the city I could draw objects like M39 without getting lost or confused.

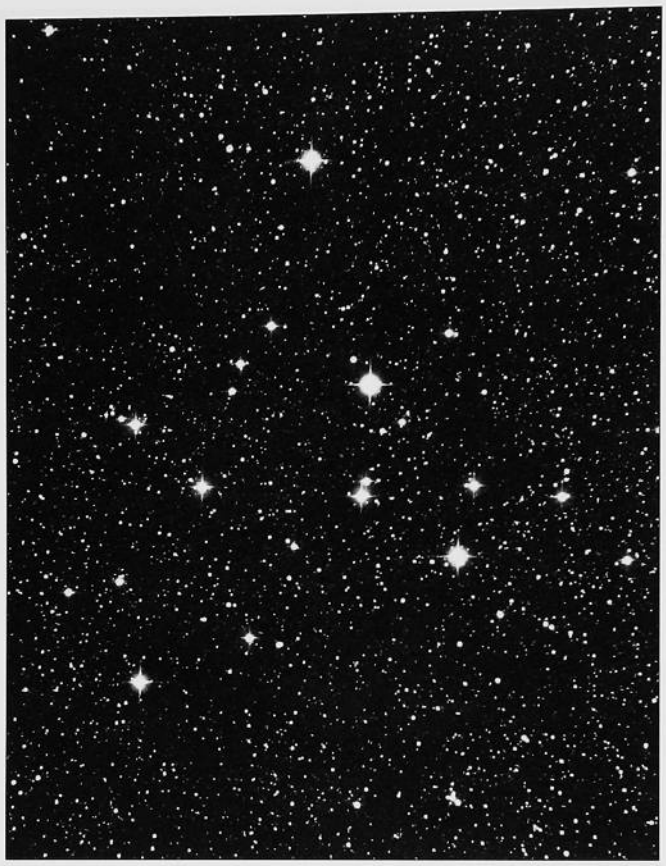
In my teenage search for the sensational, I lost sight of the real beauty of the sky — the amazing number of stars. Several years later I began to truly appreciate the Milky Way by observing the dark lanes, first with the naked eye, then with a telescope. Living at high latitudes, I could not observe the dark lanes of Sagittarius due to the typically poor transparency near the horizon, but overhead in northern Cygnus the absorbing lanes were more prominent.

I would sit for a long time simply sweeping across the Milky Way at low power watching the thick parade of stars suddenly thin out, only to recover their number by the next field of view. One of the many fascinating places to do this is near M39. A couple of degrees to the southwest we run into a nice dark break before swiftly encountering a crowded starcloud.

Returning back to M39 and letting



NGC 752 in Andromeda photographed by Lee C. Coombs (10-inch f/5 reflector, 103a-O film, 5-minute exposure).



Giant cluster M39 photographed by Preston Justis (10-inch f/6 reflector, hypered Tech Pan film, 55-minute exposure).

the sky drift for a few minutes, we soon discover a fascinating dark tube running out to the east. A friend told me that at the end of the tube the elusive Cocoon resided. I never did find this round nebulous clump, the **Cocoon Nebula** (IC 5146), with the 4.5-inch, but it is not difficult in a 10-inch.

Although as amateurs we often judge transparency by the naked eye limiting magnitude of a star at the zenith, there are two reasons I don't put a lot of weight on the process. The first is that as sky conditions degrade, nebular objects are hit harder than stellar ones. A loss of only a couple of tenths of magnitude is accompanied by a strong loss of contrast of the Milky Way dust lanes.

The second is that the prescription for my eyes changes enough over a few months to blur the star images slightly. This means that a person with sharper (or more sensitive) vision standing right next to me will reach a fainter limiting magnitude, but the sky isn't any better! A telescopic test of limiting magnitude will avoid this problem. Jim Meketa's article in *Deep Sky* #1 proposes a contrast rating based on visible Milky Way details. Try either method for yourself — see what sort of scale you prefer.

On one night of excellent observing at Paul Brown's place near the shores of Lake Huron, I managed to spy M15 with the naked eye. I've only been able to repeat that feat a couple of times since. I say it almost without effort, simply looking at the correct place in the sky and noticing two stars, the slightly fuzzy one leading a sharp one. *Sky Catalogue 2000.0* lists M15 at visual magnitude 6.35. Coincidence puts M3 at the same magnitude, but up to now I've not thought of looking for it without optical aid. Why not give both a try yourself?

M33 (NGC 598) is a well known dark sky test object. I belive it is one of the better discriminators between good and very good skies — as long as it is decently high in the sky. In eight years of observing at a site outside of Montreal, I never once saw M33 with naked eye alone. Then on my first visit to David Levy's family cottage at Jarnac, in southwestern Quebec, I spotted the Trangulum galaxy right away. I felt as if all those years I was engaged in futility. I wonder what naked-eye deep-sky object would discriminate between very good and excellent dark skies?

Not too far from M33 is the large naked-eye open cluster **NGC 752.** From Jarnac with a 63mm spotting scope at 14x, I could see two or three bright stars. This object is best viewed with as low a power as possible to make it stand out from the starfield. At medium to high power in a big scope, the cluster effectively blends into the background. The neat thing about looking through NGC 752 is that you can encounter the outer fringes of the Abell 262 galaxy cluster! There are a good number of faint galaxies playing hide-and-seek with the cluster's stars.

The Jarnac dark site offered me other rare views of the sky. Early one fall morning I spied the **California Nebula** (NGC 1499) with the 63mm at 14x without a filter. To me, it looked like an elongated mass of unresolved stars, similar to the Milky Way seen by the unaided eye. In the middle there was a distinct "kink." These days, the high tech amateur armed with an H-β filter finds the California nebula easy fare, even from just "good" skies.

So while you are out this fall, whether taking a coffee break from the eyepiece or chasing meteor streaks, try to evaluate your sky conditions based on deep-sky objects. It might give you more than a simple estimate of limiting magnitude. □

Alister Ling has contributed to Deep Sky *for many years. He recently moved back to his favorite city, Edmonton, Alberta.*

Double Stars

Crown Jewels of Cepheus

by Paul Brown

Of all the Northern constellations that keep one leg over my horizon all year long, none impresses me more than magnificent Cepheus. It is not the emission nebulae and open clusters that catch my attention, however, but the abundance of double stars. So it was during September 1990 that I plotted pairs from *Sky Catalogue 2000.0* onto *Uranometria 2000.0* and began a hunt stretching from the starry fields of the Milky Way almost to Polaris.

I warn you, some of these pairs are difficult: many require apertures over 6 inches for a clear view. If you are used to this work, enioy the trip; but, if not, start with the widest pairs first to sharpen your eye and accustom yourself to using high magnification.

For my work, I use a Pierre Schwaar l0-inch f/5.5 Newtonian employing a range of magnification from 60x to 480x. With the benefit of a heavy equatorial mount and clock drive, it is not uncommon for this telescope to show merged pairs beyond the half-arcsecond resolution limit. Of more importance, however, is the capability of the trained eye to distinguish very close pairs during moments of steady seeing.

After plotting a pair, my habit is to jot down relevant data in the side margin of the chart. Most of the data come from the *WDS* but, in the case of rapidly moving binaries, I rely on recent measures by observers such as W. D. Heintz and Harold McAlister. During the observation later on, I estimate the separation, position angle, and magnitude difference (Δm) of each pair and then compare for accuracy. Star colors and interesting field star patterns are also noted. I trust the position angle estimate most to confirm a successful observation of a sub-arcsecond pair.

ADS 14749 (Σ2780) shows a wide and easy split with 325x and is detectable, if the air is still, with half that magnification. Admiral Smyth in 1834 noted "a close double star . . . both silvery white . . . a pretty object." Measurements from *SkyCat* and Volume 1 of the Webb Society *Deep-Sky Observer's Handbook* put the separation at 1" to 1.3". My observation agrees more with the latter. Don't forget to note the beautiful starry field along with the tinted star, 7' north following. This star is listed separately in Webb's *Celestial Objects for Common Telescopes* as Es-Birm 703. It should appear as a good orange-red to those with normal color vision.

ADS 14783 (H I 48) frustrated my attempts on two consecutive niqhts despite relatively good seeing (periods of calm broken by equal periods of undulations). I could see only one round disk, whereas in October 1986 Brian Skiff found it oval to figure-8 shaped in the 24-inch Lowell refractor diaphrammed to l0 inches. The difficulty inherent with this reflected in Harold McAlister's 1984 speckle measurement of 0".413 separation. Compare this to the Webb Society's 1967 results of 0".79 indicating, at that time, only a modestly difficult pair for a l0-inch. Obviously this pair is closing. Would a sharp 12-inch still show it as a notched pair?

ADS 15600 (Σ2863) was seen by Admiral Smyth as a "splendid double star . . . both bluish" in 1839. I agree and add that it is probably one of the finest pairs in the far northern sky. It is well suited to modest apertures using low power and exhibits just enough magnitude difference to make color estimates an adventure. I see it as white and yellow but Webb said yellow and blue.

ADS 14784 (Σ2783) shows up at 325x as two disks barely touching. All my most recent data including the *WDS* indicate an equally bright 8th-magnitude pair with a separation just under 1". In contrast, I estimated a Δm of about 0.3 magnitude. Only in a measure by Charles Worley found in *Publications of the United States Naval Observatory* is a similar difference of 0.2 magnitude noted. Now, what do you see here?

ADS 1411 (OΣ34) at magnitudes 7.8 and 8.1 is an ideal brightness pair for a l0-inch. There is little excess light to confuse the image. With a current separation of a half arcsecond, I needed 325x for a notch and 480x for a figure-8 shaped image to appear elongated east-west. W. D. Heintz in 1986 placed it at 0".46 in position angle 276°.

ADS 102 (Σ2) presented no problem at 325x. It was resolved unmistakeably despite mediocre seeing. Glenn Chaple tried it with a 13.1-inch Newtonian masked to 8-inches in the fall of 1985 (see *Deep Sky* #12, 1985) with no success. At the current separation just over 0".6 and with magnitudes 6.6 and 6.9, owners of sharp 6-inch scopes might see an oval shaped image representing two merged Airy disks depending on seeing conditions. During the autumn of 1986, I notched this tight pair with an 8-inch f/7 scope using 225x.

ADS 207 (Σ13) with a separation currently just under 1", shows a figure-8 shaped image at 134x and is resolved cleanly with 325x. Being relatively bright with a small delta-m, apertures as small as 4 inches might have some success. I found it more pleasing than ADS 102 simply because it is an easier target. But what difficulty did Reverend Webb have in 1831 using his 3.7-inch refractor?

ADS 16538 (Pi Cephei = OΣ489) is included here to show the affects of a large magnitude difference on resolution. Poor seeing is magnified by larger apertures to the point where superior resolving ability is nullified. I have difficulty with Pi Cephei because the fainter secondary shows up as a disturbance against the much brighter primary. The light gets smeared by the seeing cells and interference rings around the Airy disc. As yet, I have never seen clean resolution. You will find a similar result when comparing ADS 15407 (Σ2843) and ADS 15467 (OΣ457).

ADS 15184 (Σ2816) is a wonderful triple in the heart of the IC 1396 complex and of sufficient grandeur to have been included in Admiral Symth's *Bedford Catalogue*. Save this one to relax your eyes. Althouqh this pair presented no observing challenge, some of the nearby companion pairs did, such as Stein 2852. The *WDS* lists it as having mgnitudes of 8.4 and 11.5 and a separation of 2".8 in p.a. 236°, but there is no companion closer than 20" to the primary making it a relatively easy object for small apertures. To the west lies **ADS 15160** (Σ2815). The trouble here is to split the brighter primary of the wide, 7".5 pair (magnitudes 9 and 10). With some difficulty, the l0-inch at 325x showed it aligned north-south. □

Paul Brown is an enthusiastic and experienced double star observer living in Goderich, Ontario.

Further Reading

Heintz, W.D. "Micrometer Measures Of Double Stars and New Pairs. XIII." *Astrophysical Journal*, 65, 161-174, 1987.

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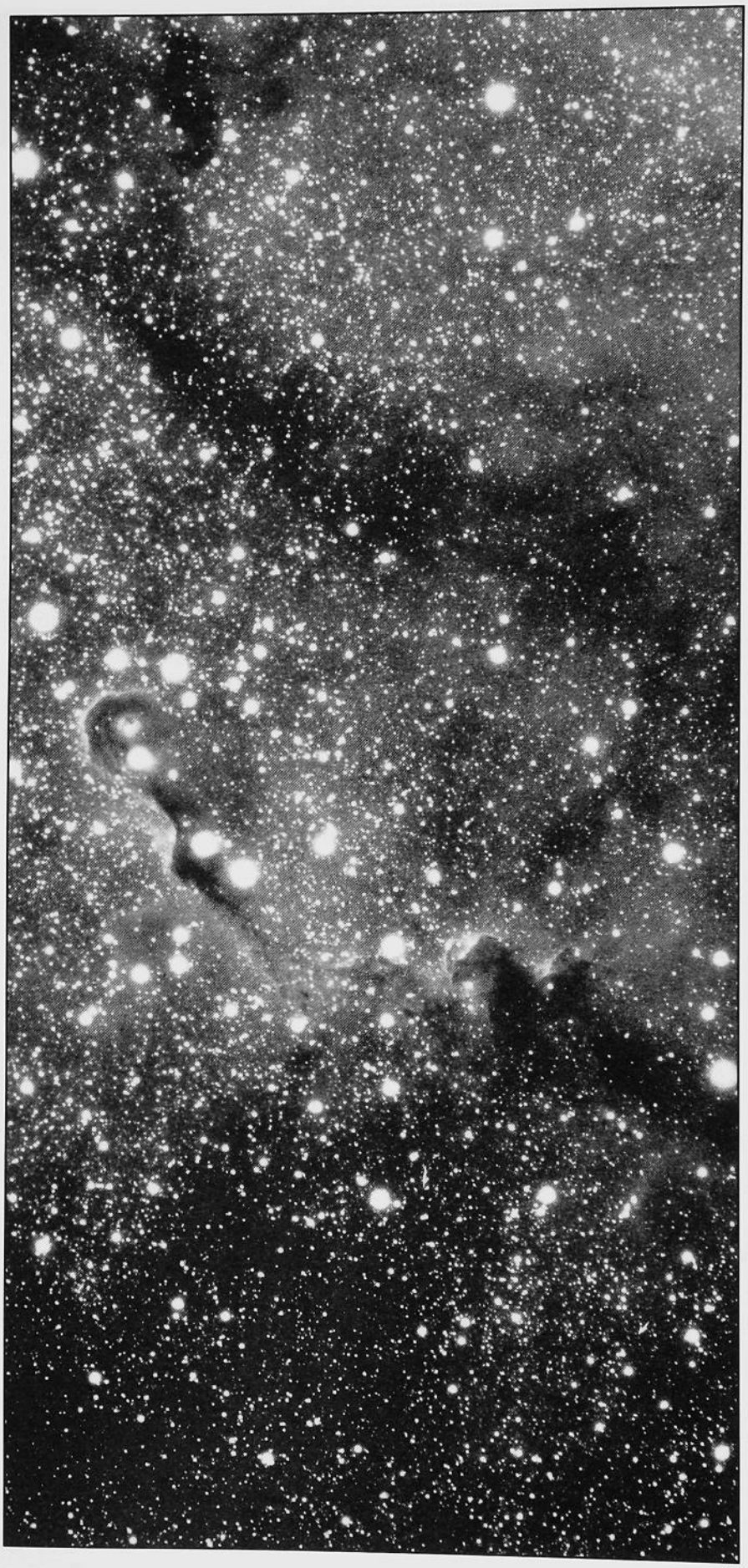
McAlister, H., *et. al*, "ICCD Speckle Observations of Binary Stars. II. Measurements During 1982-1985 from The Kitt Peak 4-m Telescope," *Astronomical Journal*, 93, 3, 1987.

Worley, C.E. and Douglass, G. G. 1984, *Washington Visual Double Star Catalogue.*

Worley, C.E. "Micrometer Measures of 2589 Double Stars," *Publications of the U.S. Naval Observatory*, 2nd Series, 25, Part 3, Washington: 1989.



Right: A closeup view of the region of emission nebula IC 1396 showing the area near the double ADS 15184. Photo by Tony Hallas and Daphne Mount.

Above: An overall view of the IC 1396 region. ADS 15184 lies near the center of the nebula. Photo by Gary Emerson.

Variable Stars

The Lure of Photoelectric Photometry

by Tom Arnold

The observatory door opened slowly by the push of an eager 14-year-old. The scene was bathed in a very low red light. The incessant beeping of the WWV receiver resounded throughout the dome. The great telescope peeked through the huge slit at the starry black velvet sky which lay beyond. Three men were busily working in the dome. One observer looked through an eyepiece on a large instrument attached to the rear of the telescope. Another was adjusting some dials on a tall equipment rack filled with back lit dials and flashing lights. The third man was bent over a chart recorder feverishly making notes on the chart paper. In a very soft voice, I asked the guide "what are they doing?" "Photoelectric Photometry," he replied. This scene occurred at the McDonald Observatory one summer night in 1964 in the dome of the 82-inch reflector. Thus began an interest which continues to this day.

Photoelectric photometry has evolved tremendously since 1964. However, the roots of determining stellar magnitudes go back nearly 2000 years to the time of Hipparchus around 10 BC. His desire was to create a catalog of bright stars, which required some method to differentiate between one star's brightness and the next. He decided on a six step brightness scale. Stars of brightness 1 were the brightest stars in the sky, while stars of brightness 6 were the dimmest stars he could see. This work stood until 1856 when N. R. Pogson redefined Hipparchus' magnitude scale so that a change of five magnitudes was exactly a 100 fold change in brightness. About the turn of the century, Stebbins and Whitford pioneered the use of the photocell to measure stellar brightness.

The next major event that shaped modern photometry was the work of Johnson and Morgan in 1953. Their work created a standard system for celestial magnitudes: the UBV system. This system not only defined brightness but provided a means of stellar color identification. This allows a star to be placed on the Hertzsprung-Russell diagram by photometric methods and not by classical spectroscopy. Today several standard photoelectric systems exist, but the UBV system remains the one used by the majority of non-professional astronomers because of its simplicity.

Any photoelectric system requires that measurements be made through special filters. In fact, it is the brightness in these colors that determine a star's spectral class and consequently its location on the HR diagram. For the UBV system the effective wavelengths of the three colors are roughly U = 3600Å, B = 4400Å, and V = 5500Å.

Although it is useful to know a star's temperature, luminosity, and basic composition, this is not the reason most non-professional astronomers employ photometry as a data gathering tool. Indeed, it is photometry's ability to make very precise magnitude determinations that makes it valuable in the study of variable stars.

For many, being able to contribute to science is the strongest motivation. Astronomy is one of the few sciences where the non-professional can make considerable contributions. There are nearly 50,000 known variable stars and only about 7,000 paid astronomers, of which only a small portion work with variables. It's easy to see that most of these variables go under observed. Many can be monitored visually but there are still many more which require photoelectric techniques. This is where the backyard photometerist enters the arena.

Organizations exist to aid the photoelectric observer in virtually all aspects of photometry. The American Association of Variable Star Observers (AAVSO) and the International Amateur-Professional Photoelectric Photometry (IAPPP) are the two leading organizations. The AAVSO concentrates on observation and aids the photometerists in data reduction and dissemination of their observations. These data are used by professional astronomers around the world. The data are also used to determine what an orbiting observatory might need to work on. The photoelectric branch of the AAVSO can be reached by contacting the AAVSO headquarters at 25 Birch Street, Cambridge, MA 02138-1205. The IAPPP is devoted specifically to photometry and provides information on hardware, software, and techniques. Through their publications, photometerists can share their observations and exchange ideas. The IAPPP can be contacted at the Rolling Ridge Observatory, 3621 Ridge Parkway, Erie, PA 16510. Anyone wishing to become involved in photometry should consider membership in one or both of these groups.

The typical photoelectric setup consists on a longer focus, equatorial mounted telescope of 8 inches or larger aperture. The photometer uses a photodiode as the detector and carries the electronics internally. The observations are made from the observers backyard where the limiting magnitude could be as bright as third magnitude. You might think that valuable work couldn't be done with such equipment under such bright sky conditions, but nothing could be further from the truth! Observations of bright stars are highly sought by professional astronomers because major observatories are designed to work with fainter objects. Bright objects are often difficult to work with. Therefore, this is an important area where considerable contributions can be made.

The typical design of a conventional photometer head is fairly straightforward. Light from the telescope passes through the telescope adapter into the photometer. The star's light is then reflected up to an eyepiece where the star is centered in the photometer. The mirror can be moved down allowing the light to pass through a small diaphragm. Light continues through one of the special filters and onto the detector. Modern detectors are either a CCD (Charged Coupled Device), photodiode, or photomultiplier tube.

The CCD is very sensitive but still quite expensive and quite complex. A photodiode is a very good detector of ultraviolet and infrared reaching 90 percent efficiency in the near infrared. This is considerably better than the photomultiplier tube in this same range. The main disadvantage of the photodiode is that all amplification of the signal from the star must be done by the electronics. This amplification by the electronics results in considerable noise with increasingly fainter stars. Clearly this limits the photodiode photometer to just the brighter stars. The photomultiplier internally amplifies the signal thousands of times before reaching the DC amplifier. This produces an excellent signal to noise ratio. By using this advantage the photomultiplier can reach much fainter objects.

Observing programs encountered

among non-professional astronomers are diverse. However, when considering a program certain practical considerations must be made. How much time can be spent observing? What is the limiting magnitude of your telescope and photometer from your observing location? Will you reduce your own data? These are just a few of the questions which must be answered before deciding on a specific program. If observing time is limited to only a few hours a week and dimmer magnitudes are a serious problem then this puts some limits on the type of variables you can usefully observe. Long period variables like the Miras or certain classes of eclipsing binaries are good observing candidates. Conversely, the ultra short period variables are good prospects for these conditions as well.

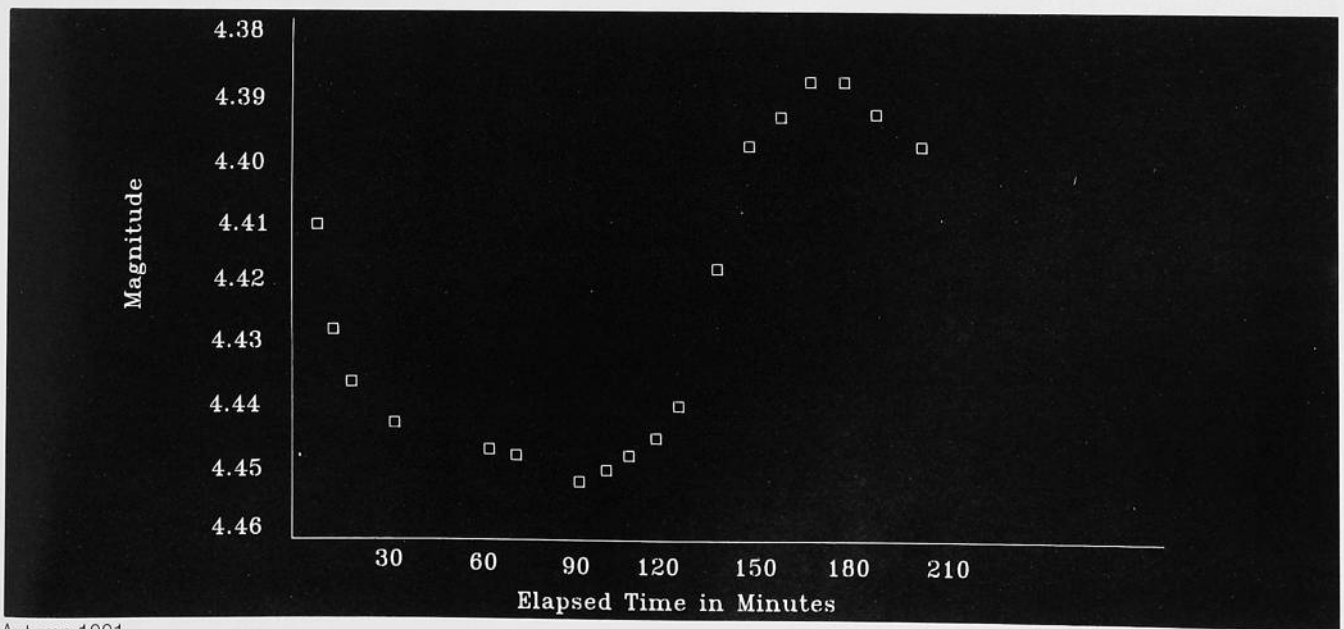
Photometry is not only more precise but far more sensitive than the human eye. Some variable stars exist that vary their light by 0.1 magnitude or less. One such class of variables are the Delta Scuti stars. Delta Scutis vary their brightness by approximately 0.1 magnitude. These variables must be observed by photoelectric means. These stars range from 0.6 to 3.5 solar masses and are very similar to RR Lyrae stars. Their spectral classes range from late A to early F and lie well within the instability strip of the Hertzsprung-Russell diagram. These stars rotate rapidly with velocities around 35 km/sec. Their spectra indicates high metal content. This is unusual because metal rich A stars usually do not vary their brightness. Delta Delphini is a prime example of this type of variable star. This is an A7 giant with published magnitude variations from 4.39 to 4.49. The period is only 0.16 day which is also consistent with other Delta Scuti stars. This star is a prime candidate for backyard photometry. It is a personal favorite which I have observed many times. In my accompanying light curve you can see the that the data indicates a slight shift from published values. This is consistent with the Delta Scuti stars since they exhibit variations in their amplitudes in a type of super period. The only way to begin to understand these stars is by massing large amounts of data on these variations. For the backyard photometerist with a bright sky and little observing time these stars are ideal. Several candidates of this class are listed above.

Indeed times have changed since that 14-year-old watched those astronomers in 1964. Equipment is smaller, more sophisticated, less expensive, and readily available to anyone wishing to take a new step into the fascinating field of photoelectric photometry of variable stars. □

Bright Stars for Photoelectric Photometry

Star	R.A.(2000.0)	Dec.	Mag.	Period
Bet Cas	0h09m11s	59°08'59"	2.31↔2.35	0.10d
28 And	0h30m06s	29°45'05"	5.18↔5.22	0.07d
44 Cet	1h24m01s	-7°59'32"	6.20↔6.22	0.70d
97 Psc	1h29m53s	18°21'20"	5.90↔5.92	0.13d
26 Ari	2h30m37s	19°51'19"	6.10↔6.15	0.08d
38 Ari	2h44m57s	12°26'44"	5.18↔5.22	0.03d
Theta[2] Tau	4h28m39s	15°52'20"	3.03↔3.40	0.07d
Omicron[2] Eri	4h15m17s	-6°11'33"	4.00↔4.05	0.08d
58 Tau	4h20m36s	15°05'42"	5.20↔5.26	0.03d
97 Tau	4h20m36s	15°05'42"	5.09↔5.11	0.04d
59 Ori	5h58m23s	1°50'13"	5.88↔5.89	0.05d
1 Mon	5h59m01s	-8°37'03"	5.93↔6.36	0.13d
28 Cnc	8h28m37s	24°08'40"	6.09↔6.10	0.10d
20 Leo	9h49m50s	21°10'46"	6.08↔6.12	0.08d
67 UMa	12h02m06s	43°02'43"	5.19↔5.21	0.06 d
4 Cvn	12h23m46s	42°32'32"	5.89↔6.15	0.21d
32 Vir	12h41m34s	10°25'35"	5.20↔5.23	0.07d
20 Cvn	13h17m32s	40°34'21"	4.70↔4.75	0.12d
V703 Sco	17h42m15s	-31°54'31"	7.80↔8.50	0.11d
Delta Sct	18h42m16s	-8°51'00 "	4.90↔5.19	0.19d
DQ Cep	20h57m30s	55°30'36"	7.22↔7.32	0.07d
Delta Del	20h43m27s	15°04'03"	4.39↔4.49	0.16d

Tom Arnold holds a BS in Astronomy from the University of Texas/Pan American. He began doing photoelectric photometry on variable stars in college almost 20 years ago. He continues the work from his backyard observatory in Houston, Texas and other "dark sky sites."



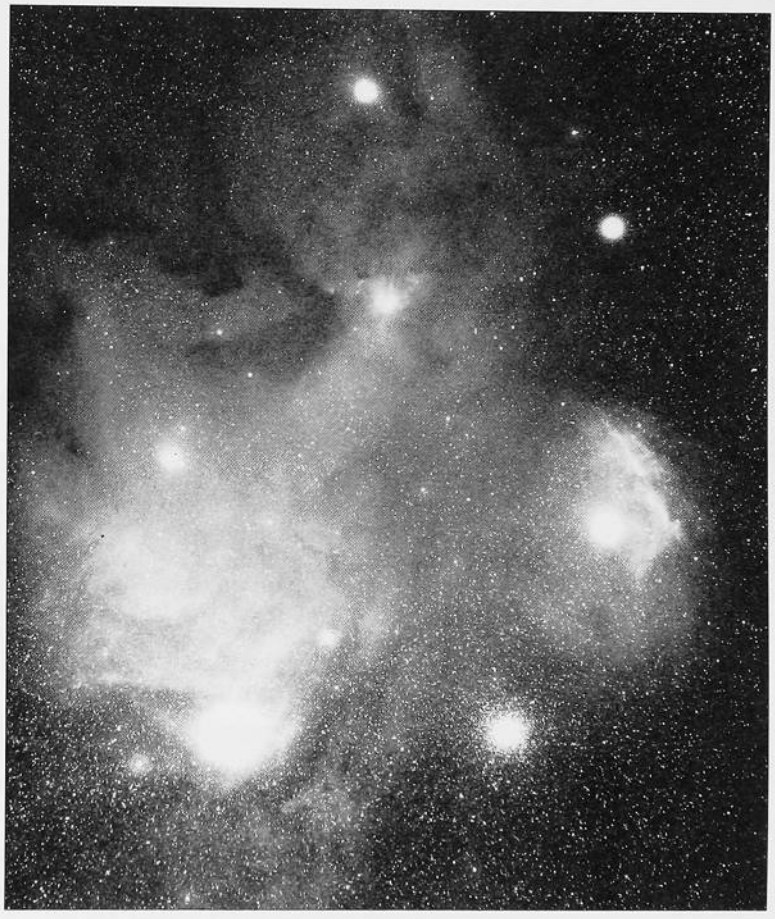
Scanning the Literature

The Latest Research News

by Brian A. Skiff

Quite a bit of good stuff has shown up in the professional journals since we made the side trip over the last five issues to discuss galaxy magnitudes. To make a start on catching up, let's begin with useful publications dealing with star clusters.

At the 1991 Texas Star Party, Barb Wilson and Larry Mitchell of Houston made several attempts each clear night to find the 14th-magnitude globular cluster Palomar 15, located in Ophiuchus. It got to be quite a joke during the week hearing Barb ask over and over in the muted hubbub on the telescope field: "Larry, where's that chart for Pal 15? I wanna make one more try..." They were ultimately successful, but perhaps having some better information about the cluster might have encouraged them.



A CCD photometric study of the cluster was published in the January 1990 *Astronomical Journal* by Patrick Seitzer and Bruce Carney ("The Obscure Globular Cluster Palomar 15," *AJ* **99**:229), the title for which Barb and Larry would certainly agree with. The color-magnitude diagram shows that the brightest stars are V magnitude 17.1. The cluster is dimmed by about 1.3 magnitudes by the obscuring dust clouds in Ophiuchus — the cluster is both obscure and obscured — and lies at a distance of 37 kiloparsecs (kpc). The paper includes a CCD finder chart and V and B-V data for the stars.

Several other color-magnitude diagrams and photoelectric sequences for globulars have been published in the last 18 months. Let's take them in order of NGC number. The group led by Chilean astronomer Gonzalo Alcaino has been busy doing CCD work on globulars. Their study of NGC 1851, a magnitude 7 object in Columba, is in the March 1990 *AJ* ("BVI CCD Photometry of the Broad Main-Sequence Globular Cluster NGC 1851"; *AJ* **99**:817). The brightest stars are V = 13.2, and so can be resolved nicely in 6-inch telescopes. Alcaino *et al.* find a distance of 12 kpc.

Writing in the March 1990 *Astrophysical Journal Suppliments*, the same group gives results for NGC 2808, one of the sky's brightest clusters, and a marginal naked-eye object near Beta Carinae ("BVRI CCD Photometry of the Globular Cluster NGC 2808"; *ApJ Suppl.* **72**:693). The brightest stars in this rich cluster are V = 13.8.

In the June 1990 *AJ*, NGC 4590 = Messier 68 is the target object ("BVRI CCD Photometry of the Metal-Poor Globular Cluster M68 [NGC 4590]"; *AJ* **99**:1831). Becasue it is located away from the obscuring effects of the Milky Way, the brightest cluster stars are V = 12.6. Alcaino *et al.* find a distance of 11 kpc, in good agreemenet with previous estimates.

All the papers just mentioned include photos (CCD images, actually) of the clusters and lists of the magnitudes and colors of the measured stars, which number into the thousands in all the papers combined.

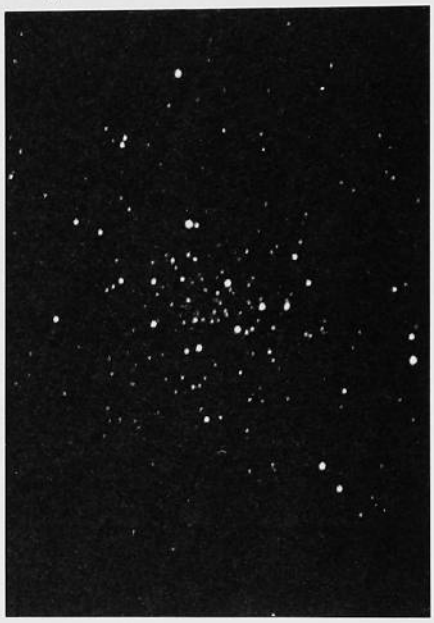
A fine study of the proper motions of stars in and around NGC 6121 = Messier 4 was in the May 1990 *AJ* ("Astrometry and Photometry in the Globular Cluster M4"; *AJ*, **99**:1491), completed by K. Cudworth and R. Rees at Yerkes Observatory. They digitally scanned a large collection of plates taken with a variety of telescopes in both hemispheres since the turn of the century. Even though the cluster is only 2 kpc away, making it the closest globular along with NGC 6397, the field stars are in the foreground and have proper motions very different from the cluster's, which is practically zero. Thus the nonmembers could be easily weeded out of the resulting color-magnitude diagram. The brightest members are 11th magnitude, and include the visually distinctive string of stars through the middle of the cluster. The paper includes an excellent large-scale photo of the cluster field.

One of the few northern globulars lacking photometric study has been NGC 6229 in Hercules. Bruce Carney and student collaborators Laura Fullton and Susan Trammell have filled this gap ("The Distant Globular Cluster NGC 6229 and Its Relation to Other Outer Halo Clusters"; *AJ* **101**:1699). Unlike M13 and M92 in the same constellation, visual observers find this object relatively difficult to resolve. For the first time we now have some good numbers to compare our observations with. Carney *et al.* estimate the distance to be 28 kpc, placing it well out into the

Left: M68 in Hydra is the subject of a recent photometric study by Gonzalo Alcaino and colleagues. Photo by Jack Metcalfe (8-inch f/10 SCT, hypered Tech Pan film, 25-minute exposure).

Below: Gemini's NGC 2420 was the target of a similar study by a group led by Barbara Anthony-Twarog. Photo by Martin C. Germano (8-inch f/10 SCT, 103a-F film, 30-minute exposure.

Opposite page: Globular M4 was recently studied by Kyle Cudworth and coworkers at Yerkes. Photo by Chuck Vaughn.



galactic halo. The brightest stars are V= 15.5, making an 8- or 10-inch telescope necessary to see more than sprinkling of threshold stars over a grainy background.

Finally, concerning globulars, are photoelectric sequences around two clusters, done by the Chilean team, led this time by Franklin Alvarado ("Photoelectric UBVRI Sequences in the Galactic Globular Clusters NGC 6752 and NGC 6864"; *AJ* **99**:1501). NGC 6752 is a very bright far-southern object similar to Messier 4, and NGC 6864 is better known as Messier 75 in Sagittarius. These sequences can help calibrate magnitudes both visually and photographically.

Turning now to open clusters, we find a few useful publications. A new CCD study of the rich, old cluster NGC 2420 in Gemini has come out from a group led by Barbara Anthony-Twarog ("A CCD Photometric Analysis of the Old Open Cluster NGC 2420"; *AJ* **99**: 1504). Although the best finder chart for stars in this cluster is published elsewhere (see the references in this paper), some interesting new results emerged. In the present study, which reaches past magnitude 18.5, the cluster is estimated to be 2.3 kpc distant, and is about 3 1/2 billion years old — one of the oldest known open clusters. Paralleling the cluster main-sequence is a weaker string of stars 0.7 magnitude above it. These represent nearly equal binary stars, which are thought to comprise roughly half the cluster members.

Photoelectric UBV photometry of the very young cluster Trumpler 37 is given by Larry Marschall and colleagues ("Photometry of the Young Open Cluster Trumpler 37"; *AJ* **99**: 1536). This object is the loose scattering of stars that fluoresces the large emission nebula IC 1396 in southern Cepheus near the red supergiant star Mu Cephei. As noted in Paul Brown's double star article elsewhere in this issue, several of the members are nice pairs. Having good magnitudes and colors for many of the star is a useful addition to the observing database.

Photometry and MK spectral types for the sparse southern cluster van den Bergh-Hagen 99 are given by a Louisiana-Argentina team lead by Arlo Landolt. Although it is located near the Eta Carinae nebula, this cluster is actually very much in the foreground, lying only 450 pc away, compared to 2 kpc for the Eta Carinae complex. Landolt *et al.* identify at least two dozen members from magnitude 6 on down in a 1° field. The cluster is of middle age, roughly 100 million years. Again, a nice chart and tables of data are provided with the article.

Next time I'll detail more papers dealing with planetary nebulae and with galaxies and galaxy clusters. Also, a discussion about the classification of star clusters inthe Magellanic Clouds. Popular atlases and catalogues bin these objects into just two types (open and globular) following the distinction used for Milky Way clusters. But the Cloud clusters are much more varied, and they cannot be split into just two types. Because the various classes have rather different visual appearances at the eyepiece, it is relevant to amateur observing to find out what's going on.□

Brian A. Skiff is senior editor of this magazine, an astronomer at Lowell Observatory, and coauthor of the 1990 book Observing Handbook and Catalogue of Deep-Sky Objects *(Cambridge University Press).*

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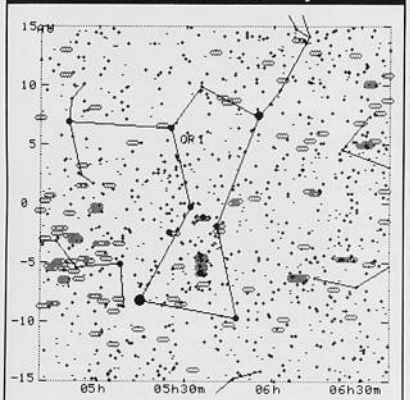

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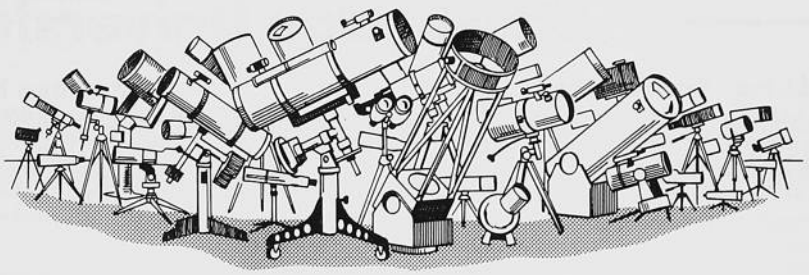

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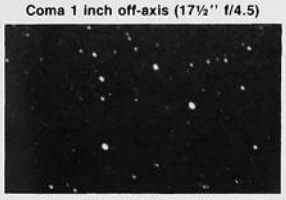
Coma 1 inch off-axis (17½" f/4.5)



Same Field with LUMICON coma corrector lens; note smaller, more numerous stars.

This computer-designed LUMICON 2" lens reduces coma and flattens the field for both viewing and photography. It threads into LUMICON 2" EASY-GUIDERS for effortless installation. This lens is optimized for f/4.5 and reduces aberrations for f/3.5 to f/5 Newtonians. Off-axis images are much smaller, making off-axis guiding far easier and yielding round pinpoint star images in photos. Since star images are sharp over a full 2¼" circle, you can use medium format cameras in addition to 35mm cameras. This zero power lens does not change image scale nor shift focus, and all lens surfaces are multi-coated for highest efficiency. Although designed for photography you may also use this lens to improve image quality in wide-field viewing with low power eyepieces.

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Filter Type	1¼"	48mm
Lumicon Oxygen-III	$99.50	$199.50
Lumicon UHC	$99.50	$199.50
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NOTE: The Oxygen-III Filter is not a substitute, but a compliment to the UHC Filter. **1 year guarantee:** You must see nebulae with the O-III filter that are **invisible** without a filter.

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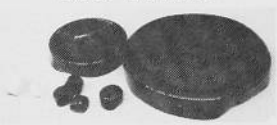

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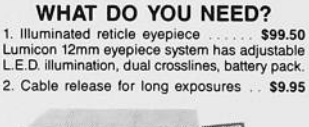

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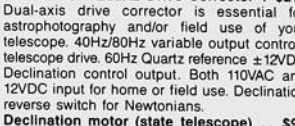

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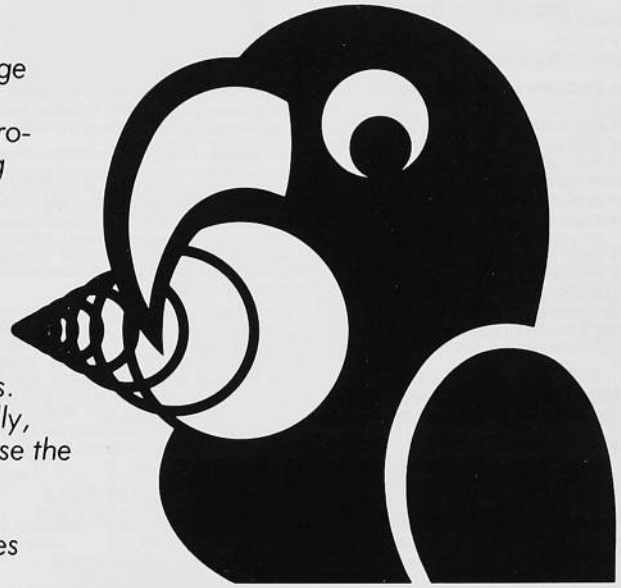

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